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BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

Volume XXI, 1905.

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BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY.

VOLUME XXI, 1905.

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Article I.—AN INTERPRETATION OF THE SLAVE-MAKING INSTINCTS IN ANTS.

By WILLIAM MORTON WHEELER.

Few animal instincts have excited keener interest among naturalists than the slave-making instincts of certain ants. This is due, no doubt, partly to the human connotations of the word "slave-making," and partly to the unique and highly specialized nature of the instincts themselves. Hence it is not surprising that conservative naturalists have regarded the accounts of these instincts as more or less incredible. Darwin was inclined to be somewhat skeptical of the magnificent pioneer observations of Pierre Huber [1] till he had himself observed a slave-making expedition of the sanguinary ant. Later the elaborate observations of Forel [2] brought full confirmation of the facts, with a wealth of additional details. Darwin was the first to attempt an explanation of the slave-making, or dulotic, instincts in a well-known passage in the eighth chapter of the "Origin." Forel and, later, Lubbock found Darwin's conclusions to be in full accord with their own observations. More recently the Jesuit father, E. Wasmann,[3] whose work on this subject is, to a large extent, compilatory and critical, has put a peculiar and, in my opinion, unwarrantable construction on the views advanced by Darwin. I sought to place the subject in a clearer light,[4] but succeeded only in eliciting from Wasmann a repetition of his misrepresentations of Darwin's views.[5] Since my article was written I have had many opportunities to study the habits of all the known species of North American slave-making ants.

---

[1] Recherches sur les Moeurs des Fourmis Indigènes. 1810.

[2] Les Fourmis de la Suisse. Zürich, 1874.

[3] Die zusammengesetzten Nester und gemischten Kolonien der Ameisen. Münster i. W., 1891.

[4] The Compound and Mixed Nests of American Ants. Am. Nat., XXXV, 1901.

[5] Neues über die zusammengesetzten Nester und gemischten Kolonien der Ameisen. Allgem. Zeitschr. f. Ent., 6, 1901; 7, 1902.

The full presentation of these observations would fill a voluminous paper, the writing of which must be postponed till a later day. At present I wish to attempt an interpretation of the slave-making instincts along somewhat more general lines and to suggest a view to which I am led by reflecting on some observations recently published in the Bulletin of the American Museum of Natural History.[1]

The ants which may be said to exhibit slave-making, or dulotic, instincts are the following:

1. *Formica sanguinea* Latr., the sanguinary ant, an holarctic species, represented by a single form in Europe, and in North America by numerous subspecies and varieties, several of which have not yet been described. In Europe the slaves of this ant are members of the *Formica fusca* group, namely, *F. fusca*, *rufibarbis*, and *gagates*. In America the number of forms which furnish the different subspecies and varieties of *sanguinea* with slaves is much greater, embracing the following members of the *fusca* group: *subsericea*, *argentata*, *subænescens*, *neorufibarbis*, *neoclara*, *subpolita*, *neogagates*, and *neocinerea* [2]; and the following members of the *pallidefulva* group (not represented in the European fauna): *schaufussi*, *incerta*, *nitidiventris*, *fuscata*.

2. *Formica pergandei* Emery, a rare and exclusively North American species allied to *sanguinea*. Slaves: *F. pallide-fulva*, *subpolita*, and *subsericea*.[3]

3. *Polyergus rufescens* Latr., the amazon ant, an holarctic species, represented in Europe by the one typical form, in North America by four subspecies (*lucidus*, *breviceps*, *bicolor*, and *mexicanus*) and probably several varieties. The European form enslaves *F. fusca* and *rufibarbis*, more rarely *cinerea*. The American *P. lucidus* enslaves only members of the *F. pallide-fulva* group, namely, *schaufussi*, *incerta*, or *nitidiventris*; *P. breviceps* enslaves *argentata*, *subsericea*, and

---

[1] A New Type of Social Parasitism among Ants. Bull. Am. Mus. Nat. Hist., XX, Oct., 1904, pp. 347–375.

[2] Although I am unable to detect any morphological differences between our American *cinerea* and the European form, it is probable that the former should be regarded as a distinct ethological variety, which I would call *neocinerea* var. nov. Professor Emery calls my attention to the fact that the European *cinerea* nests only in pure sand. Its habits have been recently described by Piéron in the following words: " . . . les *formica cinerea* vivent dans un sable de dunes, très mouvant, que le vent deplace perpétuellement, avec les aiguilles de pin qui, à peu près seules, le recouvrent." (Du Rôle du Sens Musculaire dans l'Orientation de Quelques Espèces de Fourmis. Bull. de l'Inst. Génér. Psych. 4. Année, No. 2, 1904, p. 168–185.) How different are the habits of our American form, which as I have shown (The Occurrence of *Formica cinerea* Mayr and *Formica rufibarbis* Fabricius in America. Am. Natur., XXXVI, Dec., 1902, pp. 947–952) constructs rather conspicuous mounds in the damp, black soil of grassy meadows! *F. neocinerea* is very common in certain parts of Illinois and Colorado. In the latter state I found it near Colorado Springs, nesting along the shores of Prospect Lake and in the irrigated meadows about Broadmoor.

[3] The occurrence of a mixed colony of *F. pergandei* with *pallide-fulva* was noted by Pergande, but he failed to show that the former species is dulotic. Some years ago Rev. P. J. Schmitt, O. S. B., sent me specimens from Colorado, mixed with *subsericea* workers. Aug. 8, 1903, I found at Broadmoor, near Colorado Springs, a small colony of *F. pergandei* comprising four winged females and about fifty workers living with an equal number of *subpolita* workers. This observation, taken in connection with the close taxonomic affinities of *pergandei* with *sanguinea*, forcibly suggests dulosis.

neocinerea; P. bicolor only *F. subænescens.* The slave of *P. mexicanus* is unknown.

4. *Tomognathus sublævis* Nyl. of Northern Europe. Slaves: *Leptothorax acervorum* or *muscorum.*

5. *Tomognathus americanus* Emery of the Atlantic States. Slave: *Leptothorax curvispinosus.*[1]

6. *Strongylognathus*, a genus represented, so far as known, only by the European and North African species *huberi*, *cæciliæ*, *christofi*, *afer*, and *testaceus*. The slave of *huberi*, *testaceus*, and *afer*, the only forms of which the habits are known, is *Tetramorium cæspitum*. It is doubtful whether any of these species are truly dulotic. They are probably all permanent social parasites.[2]

It thus appears that only the sanguinary and amazon ants furnish us with unmistakable dulotic instincts. Until the much rarer species of *Tomognathus* and *Strongylognathus* have been more thoroughly studied, we may omit them from the discussion, especially as they are known to present no peculiarities that would contradict the conclusions reached in this paper. The sanguinary and amazon ants represent, however, two very different subtypes of dulosis. The former is not dependent on its slaves, as it is an active worker, able to excavate its own nest, care for its young, and obtain food without assistance from other ants. *Polyergus*, on the other hand, has reached a highly specialized stage of dulosis: it is unable to feed itself, excavate the earth, or care for its own offspring. Hence it is absolutely dependent on its slaves and exhibits a high degree of precision and proficiency in obtaining the larvæ and pupæ that will become slaves on hatching. In any attempt to interpret the dulotic instincts we are therefore compelled to centre our attention on the sanguinary ant; this is the crucial form, on an accurate understanding of which must depend any satisfactory explanation of dulosis.

---

[1] I have recently had the good fortune to find three *T. americanus* + *L. curvispinosus* colonies in hollow twigs of elder bushes in rather damp, shady woods near my home at Bronxville, N. Y. One of these colonies contained only a single *Tomognathus* worker, another six and the third eight workers and a *Tomognathus* queen. The latter insect is not at all ergatoid, like the female *T. sublævis* described and figured by Adlerz (Myrmecologiska Studier. III Tomognathus sublævis Mayr. Bihang till K. Svenska Vet. Akad. Handl., XXI, 4, No. 4, 1896, 76 pp., 1 pl.), but decidedly larger (3.5 mm.; the worker measures only 2.5 mm.) and has three ocelli and a typical female thorax, showing distinct traces of having borne wings. All of the colonies contained larvæ and pupæ, presumably of both species, but no queens of *L. curvispinosus*. I am not at all convinced from my brief study of one of these colonies in an artificial nest, that our American species is dulotic. For that matter, Adlerz failed to establish this fact beyond question for the European species. Both may be true inquilines or permanent social parasites. In the same locality in which I found the three above-described colonies, I found a mixed, queenless colony of the yellow *L. curvispinosus* and the black *L. longispinosus*, inhabiting a hollow elder twig. Now if a deälated *T. americanus* queen should establish her colony in such a nest as this, we should have a case like Alderz's case of *T. sublævis* living with two species of *Leptothorax*, but the inference that the latter indicated repeated slave-making expeditions on the part of the *Tomognathus* would be erroneous.

Since the female *T. americanus* is so very different from the female of the European species, it may be well to regard the former as belonging to a distinct subgenus, for which I would suggest the name *Protomognathus* subgen. nov., for the purpose of indicating that the American is less advanced phylogenetically than the European *Tomognathus*. This is, of course, frequently the case with American as compared with allied European forms. Compare, *e. g.*, the parasitic ant *Symmyrmica chamberlini* with the allied European *Formicoxenus nitidulus*.

[2] I find that the term "social parasitism," employed by Forel and myself to designate the parasitism of one colony of organisms on another colony, has been used in a very different and purely sociological sense by Massart and Vandervelde (Parasitisme Organique et Parasitisme Social. Bull. Scientif. France et Belg. Tome XXV, 1893, 68 pp.) The authors restrict the term to human society in which certain individuals become parasitic on others of the same species.

In all previous attempts to explain dulosis, authors have gone at once to the most salient instinct of *sanguinea*—its tendency to make forays on other species, kidnap their young, and permit these to develop into auxiliaries. This is undoubtedly the striking character of the whole phenomenon. But a too exclusive interest in this matter has, in my opinion, withdrawn attention from certain other instincts of considerable importance. Foremost among these are the instincts relating to the founding of the *sanguinea* colony. In a question which involves the phylogeny of the instincts exhibited by adult colonies of ants, it is necessary to study the instincts of young and incipient colonies; inasmuch as a colony, being an individual of a higher order, may reasonably be expected to conform more or less closely to the biogenetic law. To my knowledge no accurate and irrefutable observations on the founding of *sanguinea* and *Polyergus* colonies have ever been made either in Europe or America. We do not know how the *sanguinea* colony comes into possession of its first batch of auxiliaries. Two alternatives suggest themselves. The *sanguinea* queen may be able to establish a formicary and bring up her first brood of workers all by herself, after the manner of the majority of ants, and the first batch of slaves may be acquired by dulosis. On the other hand, it may be impossible for the *sanguinea* queen to bring up her own young. For this purpose she may have to enter a small or depauperate colony of the auxiliary species. In this case the sanguinary ant in the earlier stages of colony formation would be a true social parasite, and dulosis would be due to the manifestation of later, superadded instincts. The little evidence that can be produced is indirect, but I am inclined nevertheless to accept the latter of these two alternatives as the more probable, for the following reasons:

1. Although isolated *sanguinea* queens are often seen running about on the ground and seeking suitable nesting sites, no one, to my knowledge, has been able to show that these insects can found colonies without the assistance of alien workers.[1]

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[1] Wasmann (Die zusammengesetzten Nester, etc., p. 201) does, indeed, make the positive statement: "Eine befruchtete Konigin von *Formica sanguinea* kann allein, ohne Mitwirkung eigener oder fremder Arbeiterinnen, eine neue Kolonie gründen," but when we turn to the passage to which he refers in Blochmann's paper (Ueber die Gründung neüer Nester bei Camponotus ligniperdus Latr. und anderen einheimischen Ameisen. Zeitschr. f. wiss. Zool., XLI, 1885, p. 725) we find only the following remark: "Ich will darum auch nicht auf weitere Einzelheiten eingehen, sondern nur noch die Arten nennen, von denen ich einzelne Weibchen mit Eiern, Larven etc.,

2. Near Rockford, Ill., I found two colonies each containing seven to twelve callow *sanguinea* workers, whereas the *subsericea* workers in the same nests, numbering not more than a dozen in either case, were very large and mature. The latter could not, therefore, have been kidnapped as larvæ or pupæ by the *sanguinea* workers.

3. These two, as well as several other small *sanguinea* colonies I have seen, are very similar to the incipient colonies of *F. consocians-incerta.* As I have shown,[1] the small yellow female of the former species seeks out and enters, as a convenient place in which to start her own formicary, some depauperate and probably queenless nest of *F. incerta.* The *consocians* young are reared by the *incerta* workers and when the latter have sufficiently increased in numbers they emancipate themselves from the workers of the host species and eventually become a pure and independent colony of considerable size. The *sanguinea* would differ from the *consocians* colony in becoming dulotic instead of emancipating itself. That the colonies of other dulotic ants, like *Polyergus* and *Strongylognathus*, are founded in the same manner as the *consocians* colony, is hardly open to doubt.[2]

4. The fact that in its structure *sanguinea* is much more closely related to ants of the *rufa* group, like *F. consocians*, than to other species of *Formica*, may also suggest a tendency towards temporary parasitism at least during the period of colony formation.

5. Like *F. consocians*, *F. sanguinea* shows a tendency to emancipate itself from the auxiliary species when its colonies become old and populous. It has been repeatedly observed that the smallest *sanguinea* colonies contain the greatest number of slaves, whereas those of large size tend to become pure *sanguinea.* Wasmann attempts to minimize the number of slaveless colonies and claims that

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im Freien vorfand, theils auch solche zu Hause hielt. Es waren das: *Formica fusca, sanguinea; Lasius niger, umbratus.*" This remark is rather general and vague, since it omits the very "Einzelheiten" that would justify Wasmann's statement. Moreover, the accurate identification of single dealated females of *Formica*, especially of the forms with red thoraces and black abdomens, is a delicate matter, and it is by no means impossible that Blochmann may have mistaken a *F. rufibarbis* for a *sanguinea* queen, notwithstanding the clypeal notch which is so distinctive a character of the latter species. So careful and experienced a myrmecologist as Wasmann recently mistook for *rufibarbis* two *F. truncicola* queens which he found in *F. fusca* nests (Neues über die zusammengesetzten Nester, etc., p. 77).

[1] A New Type of Social Parasitism, etc.

[2] I attribute very little value to Wasmann's conception of "alliance-colonies" as distinguished from "adoption-colonies." It is highly improbable that in a state of nature, two colonies of different species, both containing adult workers, ever fuse to form a mixed colony. Such an appearance is produced by a colony of one species adopting a dealated queen of another species *plus* the young of the latter after they have been reared. A superficial observer would interpret the young *consocians-incerta* colony as an "alliance," but he would be very wide of the mark. Wasmann's table, therefore, again requires revision and readjustment to the facts. His classification is clearly vitiated by his using as *differentiæ* sometimes the method of colony formation (*i. e.*, the behavior of the isolated queen), sometimes the behavior of the adult workers or colony as a whole. Thus *Polyergus* and *Strongylognathus* would belong in two categories, since they are adoption-colonies in their younger stages and later on "Raubkolonien." A more natural classification would recognize three groups of cases: temporary parasitism, dulosis, and permanent parasitism; the first comprising such forms as *F. consocians*, *F. dakotensis*, etc.; the second, *sanguinea* and *Polyergus* and possibly also *Tomognathus* and *Strongylognathus huberi;* and the third, *Anergates*, *Strongylognathus testaceus*, etc.

in an examination of 410 *sanguinea* colonies occurring over an area of four square kilometres near Exæten, Holland, he found only one in forty to be without slaves. And he proceeds to extend his conclusions to the American forms. In the first place he doubts whether the subspecies *aserva*, described by Forel from Canada, is really as slaveless as its author supposed. Forel saw only one large colony of this subspecies, which is closely related to the common European form and appears to be largely confined to British Columbia and the mountains of the northern United States. I have seen some eight or nine colonies of *aserva*, in Colorado, Wisconsin, and Connecticut, but in only one of these did I find a few slaves, although none of them were very large. I have also recently received numerous *aserva* workers without slaves from a colony collected in the Porcupine Mountains, Michigan, near Lake Superior.

F. aserva, however, is not the only North American form of *sanguinea* which shows that Wasmann has been too hasty and confident in his generalizations. July 26, 1903, I made an excursion to Woodland Park, Colo., which is located in the Ute Pass at an altitude of about 8500 feet. At this place I came upon an enormous number of colonies of a form of *sanguinea* closely related to the common subspecies *rubicunda*. These colonies, small, of medium size, and very large, were everywhere in the woods — in and under pine logs and stumps, under stones, about the roots of plants, etc. I devoted an entire day to their examination and excavated 106 of them by actual count, but succeeded in finding slaves (*F. subsericea*) in only two medium-sized colonies! I may have overlooked a few slaves in some of the nests, but I feel confident that less than one per cent of the colonies contained auxiliaries. That this condition of the species was not due to any lack of the requisite auxiliaries was proved by the fact that there were many nests of *F. subsericea* and *F. subpolita* in the immediate neighborhood. The *sanguinea* workers were, of course, doing all their own work, collecting dead insects, attending aphides on the aspen leaves, and visiting the large fimbriated nectaries on the green petals of the strange gentianaceous *Frasera speciosa*, which is not uncommon in the Ute Pass at an altitude of over 7000 feet. These observations show, first, that *sanguinea* is a highly variable species in respect of the slave-making instinct; second, that this instinct is by no means so firmly established in heredity as Wasmann would have us believe, and third, that there is an unmistakable suggestion of something like the temporary parasitism of *F. consocians* and other forms of *rufa*, *exsectoides*, etc. The Ute Pass *sanguinea* may emancipate itself from the species (*subsericea*) in whose nests its colonies are probably started, very much sooner than the European *sanguinea* or the subspecies and varieties of the Eastern and Middle States of the Union.

We come now to the vital point of dulosis. As I have said before, there is this striking difference between colonies of *sanguinea* and *Polyergus* on the one hand, and those of such species as *F. consocians* on the other, that in the former we have additional instincts which lead the colony to add to its personnel by robbing the young from other colonies of the auxiliary or host species. It is clear that a specialized instinct or group of instincts cannot arise from nothing, but must be traced to pre-existing instincts of a simpler, more generalized and primitive nature. If successful such tracing amounts to an explanation in a scientific sense, although we may still be unable to account for instinct as such. Now this tracing of dulosis to more general and better understood instincts was exactly what Darwin proposed to do in the well-known passage, which I again quote for the sake of the argument:

"By what steps the instinct of *Formica sanguinea* originated I will not pretend to conjecture. But as ants, which are not slave-makers, will, as I have seen, carry off pupæ of other species, if scattered near their nests, it is possible that such pupæ originally stored as food might become developed; and the foreign ants thus unintentionally reared would then follow their proper instincts, and do what work they could. If their presence proved useful to the species which had seized them—if it were more advantageous to this species to capture than to procreate them—the habit of collecting pupæ originally for food might by natural selection be strengthened and rendered permanent for the very different purpose of raising slaves. When the instinct was once acquired, if carried out to a much less extent even than in our British *F. sanguinea*, which, as we have seen, is less aided by its slaves than the same species in Switzerland, natural selection might increase and modify the instinct—always supposing each modification to be one of use to the species—until an ant was formed as abjectly dependent on its slaves as is the *Formica* [*Polyergus*] *rufescens*."

Darwin here traces the specialized slave-making instincts to the more primitive and general, and therefore better known hunger and foraging instincts, or rather to a somewhat modified form of these instincts as they are widely, if not universally, exhibited by ants. The slaves are a by-product which is conceivably useful, though their presence in the colony is the result of activities not undertaken with a view to their acquisition. The explanation is analogous to that often used in morphological derivation, as, for example, in accounting for animal pigments as due in the first instance to a detention of excretory by-products in the integument. In the case of *sanguinea* the "survival value" of the colony may be increased by the presence of the auxiliaries and the instinct to acquire them may therefore be supposed to have been perpetuated and intensified by natural selection. This view was accepted by Forel and Lubbock after a much more searching study of *sanguinea* than Darwin had been able to make, and I had come to the same conclusion in my paper on the compound nests and mixed colonies. The many observations which I have since been able to make on these ants, both in the field and the laboratory, have only confirmed me in the opinion that Darwin's interpretation is in close accord with the facts. Wasmann, in commenting on my paper, misses the whole point of the discussion and runs full tilt at sundry wind-mills of his own construction. Neither Darwin, Forel, nor myself ever stated that natural selection created the dulotic instinct. It has long been evident to every thinking zoölogist that selection cannot account for the origin of an instinct variation, any more than it can account for the origin of a structural variation ; but given the variation, whether it arise by mutation, continuous variation, in a definite or indefinite manner, or what not, it is perfectly conceivable that it may be strengthened by natural selection.[1] At any rate, Wasmann has failed to show that this is impossible either in dulosis or in any other case. The merit of Darwin's explanation lies in the fact that he did not in this instance seek to explain the origin of a variation by means of natural selection, but sought to show how a given instinct—namely, that of robbing larvæ for food—could be modified by other impulses till it became what we call the slave-making instinct.

Wasmann's objections, however, really come down to a question of fact. He maintains that the *sanguinea* rob the larvæ and pupæ of other ants, in obedience to a special inherited instinct, for the sake of rearing them. He concludes: "dass in dem sinnlichen Vermögen der Raubameise eine bestimmte Verbindung bestehen müsse zwischen den Vorstellungen welche auf die Hilfsameisen, auf deren Puppen und auf die Puppenjagt sich beziehen." He is not such a bad psychologist, however, as to pretend that these "Vorstellungen" or images (of the nature of contact-odors, in this case) could be inherited as such, for he, of course, recognizes the fact that the *sanguinea* workers must carry out their very first slave-making foray successfully, if we are really dealing with an instinct. "Es bleibt also nichts übrig als die Annahme, dass die jungen Raubameisen bereits eine instinktive Neigung zum Sklavenraub mit auf die Welt bringen. Dasselbe gilt auch für die Erziehung der Sklavenpuppen, kurz für die ganze Sitte Sklaven zu halten." He does not see that he here begs the whole question: the *sanguinea* make slaves because they are gifted with a slave-making instinct!

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[1] As de Vries (Die Mutationstheorie, Bd. 2, p. 667) tersely says: "*Die natürliche Auslese ist ein Sieb*, sie schafft nichts, wie es oft fälschlich dargestellt wird, sondern sichtet nur. Sie erhält nur, was die Variabilität ihr bietet. Wie das, was sie siebt, entsteht, sollte eigentlich ausserhalb der Selectionslehre liegen. Eine Frage ist es, wie der grosse Wettkampf siebt, eine andere, wie das Gesiebte entstanden war. In beiden Hinsichten ist auch jetzt noch die ursprüngliche Ansicht Darwin's die beste von Allen, doch ist die Sachlage von späteren Schriftstellern vielfach getrübt worden."

A more satisfactory result is reached when he tries to resolve the dulotic instincts into a catenary reflex, although he fails to notice that in so doing he is practically restating in ontogenetic terms Darwin's view of the phylogeny of the instincts in question: "Die instinktive Neigung zum Sklavenraub regt sich erst nur als unbestimmte Beutelust; der Geruch der Hilfsameisenart lenkt diese Beutelust auf die richtige Fährte, auf die Plünderung eines benachbarten Sklavennestes; die geraubten Arbeiterinnenpuppen erregen in den Raubameisen die Neigung zur Pflege derselben, bis schliesslich die ersten Hilfsameisen in dem Räubernest das Tageslicht erblickt und ihren Chitinpanzer ausgefärbt haben und sich als angenehme Gefährtinnen thatsächlich bewähren." Of course, it is only after the first dulotic expedition that associative memory and habit could come into play to strengthen the instinct.[1]

Now the point on which I continue to differ from Wasmann is his too restricted view of the behavior of the existing forms of *sanguinea* toward the kidnapped young. The statement, "die geraubten Arbeiterinnenpuppen erregen in den Raubameisen die Neigung zur Pflege derselben," implies a very partial interpretation. In my opinion, it refers to a secondary instinct, variable in its intensity even in the existing forms of *sanguinea*, and by no means supplanting the primitive larva- and pupa-eating instincts of the species. It is probable that the auxiliary species are doubly useful to the *sanguinea:* both as food and as helpmates in the colonial activities. In other words, *sanguinea* may owe its survival quite as much to the adroit utilization of a rich and convenient food supply, which feebler ants are compelled to forego, as to the keeping of auxiliaries. The question is, therefore, whether there are any facts that support this contention. I believe that they exist and have been, moreover, in great part enumerated in my former paper, though ignored by Wasmann in his reply:

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[1] Wasmann is not at liberty to construe Darwin's words "for the very different purpose of raising slaves" in conformity with his own views, inasmuch as the word "purpose" is often used in a different and more general, albeit still teleological connotation, as, for example, when we say "the plant unfurls its petals for the purpose of exposing its pistils and stamens and of attracting insects."

1. Ants are very generally fond of appropriating the larvæ and pupæ of other ants whenever there is an opportunity. Such larvæ and pupæ are not killed at once, but kept in the chambers of the nest and eventually either partly or wholly eaten. These instincts are so universal among the different species that they cannot be said to be absent in *sanguinea.* On the other hand, many ants besides *sanguinea* occasionally neglect some of the foreign young and permit them to hatch and become active members of the colony. Whenever these intincts are tested, either in natural or artificial formicaries, by giving ants larvæ or pupæ of another species, we find that, in comparison with the number of alien young appropriated, the number of surviving auxiliaries is remarkably small.

2. We know that certain ants, like the smaller species of *Eciton* of tropical and subtropical America, make a regular business of robbing the larvæ and pupæ of other ants indiscriminately. In this they are quite as expert and intrepid as *Polyergus.* The kidnapped larvæ and pupæ, often of several species, are stored up in the nest as fresh food in a convenient form to be eaten at leisure. But in this case, even if some of the pupæ were permitted to hatch, there could be no slaves, since the Ecitons do not occupy permanent nests, but lead a nomadic life.

3. Some of our northern ants at times display the same instincts as *sanguinea* and as a consequence form mixed colonies with other species. Adlerz maintained[1] that *Lasius niger* occasionally appropriates the larvæ and pupæ of *L. flavus*, and that the latter may hatch and function as slaves in the nests of the former species. Wasmann seeks to discredit these observations on what seem to me to be very inadequate grounds. He suggests that such mixed colonies, if they exist at all, probably result from the "accidental alliance" of two fertilized queens of the different species. During the past three summers I have found altogether six mixed colonies, each consisting of two species of *Lasius.* Two of these, found near Rockford, Illinois, consisted of *L. myops* and *americanus*, and four found at Colebrook, Connecticut, consisted of *L. latipes* and *americanus.* In none of these cases was there any doubt about the "mixed" character of the colonies, as the insects were taken alive and kept for some time in arti-

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[1] Myrmecologiska Notiser. Entomol. Tidskr., XVII, H. 2, 1896, p. 131.

ficial nests. All of these colonies were small and in none of them was it possible to find a queen of either species. The simplest explanation of such cases is certainly not by alliance of fertile queens but, as Adlerz has maintained, by dulosis.[1]

4. Even *sanguinea* shows a tendency to lapse into the ancient instinct of plundering the nests of different species of ants indiscriminately. Forel (*loco citato*, p. 363) has described forays of *sanguinea* on *Lasius niger* and *L. flavus*, and similar observations have been made by Wasmann. I once witnessed a ridiculous foray of a large *rubicunda* colony on a colony of a woodland variety of *Myrmica scabrinodis*. In this instance the foray was carried out exactly as if it had been directed against one of the normal auxiliary species. After killing or putting to flight the *scabrinodis* the *rubicunda* returned to their nest with the small larvæ and pupæ of an ant, which belongs to an entirely different subfamily. In another *rubicunda* nest under a log in the same wood, I found two of the flat chambers full of uninjured pupæ of *Myrmica scabrinodis*. They had evidently been set apart from the *sanguinea* young and from those of the normal auxiliaries (in this case *F. subænescens*). Forel made a similar observation on a *sanguinea* nest in which *Lasius niger* and *L. flavus* cocoons had been stacked up in a chamber by themselves. A large colony of *F. subintegra*, near Rockford, Ill., was seen one morning to make a normal assault on a *Lasius americanus* colony and return to the nest with a number of larvæ and pupæ in their jaws and many *Lasius* workers hanging to their legs and antennæ. These forays, which are probably not at all infrequent and are, moreover, undoubtedly undertaken by *sanguinea* colonies of considerable size and of some experience in capturing the normal auxiliaries, point directly to something very closely akin to hunger as the impulse which compels the workers to undertake their expeditions. We can hardly suppose that the *sanguinea* workers, even after some practice in making slaves, have any definite association between the kidnapped young and the slaves to be reared from them or they would not make forays on such unsuitable species. The contact-odor sensations of a *sanguinea* worker that is kidnapping *Lasius* and *Myrmica* larvæ and pupæ must be of a very different nature from the corresponding sensations experienced in a foray on the normal auxiliaries.

5. Although a *sanguinea* colony kidnaps great numbers of larvæ

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[1] The mixed colonies of *L. latipes* and *americanus* are especially remarkable on account of the great difference in the odoriferous secretions of the two species. The workers of *L. americanus* have a faint and rather indifferent odor whereas those of *latipes*, like all our species of the subgenus *Acanthomyops*, have a very striking odor like oil of citronella.

and pupæ during the course of a summer, there is no commensurate growth in the number of its auxiliaries. I observed during the greater part of a summer a large *subintegra* colony in Mr. Ralph Emerson's garden at Rockford, Ill. The ants made almost daily forays on the numerous *subsericea* colonies nesting in different parts of the lawn and carried home thousands of larvæ and pupæ. Some of these forays extended over two whole days. But when I came to examine the *subintegra* colony in the autumn, it contained, if anything, fewer slaves than early in the summer. What became of all the larvæ and pupæ carried home if they were not eaten or thrown away? Similar consumption and neglect of larvæ and pupæ may be readily seen in artificial nests, although such observations are open to the objection that the ants may be compelled to feed on the young of the auxiliary species, just as they sometimes feed on their own young, through lack of proper animal food. It is not impossible that in cases like the Ute Pass colonies above described, where a great many *sanguinea* colonies inhabit a comparatively small area, the slaveless condition may be due to a complete consumption of all the kidnapped larvæ and pupæ.

6. The fact that the largest and oldest *sanguinea* colonies contain fewer or no slaves cannot be explained on Wasmann's assumption, since this would lead us to expect a stable or constantly increasing dulotic instinct as the colony grows in size. The fact is, however, readily explained on the view that even our existing forms of *sanguinea* really rob, not for the purpose of making slaves, but for food. Under these circumstances the chances of survival of alien larvæ and pupæ would naturally tend to diminish and even to disappear with an increase in the number of the *sanguinea* workers.

The above phenomena are all readily explained if we adopt Darwin's view of dulosis, but on Wasmann's they are isolated, incomprehensible anomalies.

The fact remains, however, that *sanguinea* is, as a rule, *discriminatively* predatory, and this peculiarity neither Darwin nor Wasmann have been able to explain. In other words, why does *sanguinea* normally confine its forays to colonies of ants belonging only to the *pallidefulva* and *fusca* groups of *Formica*, with a pronounced predilection for the typical *fusca* in Europe and its variety *subsericea* in America? I believe that we may account for this instinct by reverting to previous considerations. The *sanguinea* queen, as I have stated, very probably establishes her colony in a depauperate nest of the auxiliary species. She is a parasite, like *F. consocians*, and as such seeks adoption in the nest of a particular species. The same explanation will account for this instinct that will account for the association of any parasite with its host. Now the *sanguinea* workers are, of course, abortive females, and may be supposed to inherit in some degree the instinct to seek out nests of the same species on which the queens are parasitic. If we do not wish to assume such an inherited instinct on the part of the workers, we may, perhaps, regard the discriminative tendency as acquired by habit-association, since the worker *sanguinea* is from the first brought up in nests containing the auxiliary species. This instinct or habit has merged in the workers with the more ancient and more universal formicid instincts to rob the young of other ants and to forage in files or companies. The result of this fusion of various instincts, combined with an enterprising and pugnacious disposition, leads to the typical dulotic foray. If this view of the matter is correct, the discriminative character of the foray has its root in the discriminative parasitism of the queen.

To complete the interpretation of the dulotic instincts and account for the presence of the slaves in the *sanguinea* colony we have to admit the existence of still another set of instincts, which are also nearly if not quite universal in ants. These are manifested in part by the adult *sanguinea* and auxiliaries already in the colony and in part by the callows hatching from the kidnapped pupæ. The adult workers permit or even assist the alien young to leave their cocoons and pupal envelopes, and the callows remain in the colony and mature with a sense of being its regular component members. The instincts thus manifested on the part of two different species towards each other are obviously the same as those which render colonial life possible in either of the species by itself. Wasmann seems to think that *sanguinea* has much more highly developed philoprogenitive instincts than other species of *Formica*. At any rate, such a conclusion is implied by his assumption that these ants really go out of their way to raise slaves. I am not prepared to entertain this view. The young are reared and cared for by the more recently hatched workers of *both* the species, for in *sanguinea*, as in many other ants, the callows serve an apprenticeship in the nursery before they leave the nest to forage. We may designate the various instincts which relate directly to the rearing and care of the young and influence the attitude of the young towards the remainder of the colony, as threptic instincts.[1]

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[1] Some such term seems desirable for use in a purely ethological sense. It is, of course, derived from the same root as *trophic*, but this word is more properly used with a purely physiological connotation.

Some remarkable experiments recently performed by Miss Fielde[1] throw a flood of light on the formation of mixed colonies in general and on the formation of the dulotic colonies in particular. The ease with which she succeeded in making artificial mixed colonies of ants belonging to the most different subfamilies shows how plastic are the threptic instincts even in species which under natural conditions are never known to live in symbiosis. The simple conditions under which such colonies were formed are thus described by Miss Fielde: "If one or more individuals, of each species that is to be represented in the future mixed nest, be sequestered within twelve hours after hatching, and each ant so sequestered touch all the others with its antennæ during the three ensuing days, these ants will live amicably together thereafter, although they be of different colonies, varieties, species, genera, or subfamilies. For sequestering the ants, I used artificial nests, made in watch-glasses so small that the natural movement of the newly-hatched ants would bring each of them into contact with all the others. In no case did the callows quarrel, and those of most diverse lineage sometimes snuggled one another. The ant's sense of smell appears to be perfectly acquired, and its standards of correct ant-odor to be established during the first three days after hatching. Any two species or any number of species that I captured for use in these experiments became accustomed to each other's odor, and therefore friendly, if the early association was close and continuous. This association is more perfect when no inert young distracts the attention of the callows from one another, and when the arrangement of the nest offers no place of seclusion for any of its inmates." By these methods Miss Fielde succeeded in producing among others such startling mixed colonies as the following:

Lasius latipes + *Stenamma fulvum;*
Formica sanguinea + *Cremastogaster lineolata;*
Stigmatomma pallipes + *Formica subsericea* + *S. fulvum;*
L. latipes + *F. lasioides* + *S. fulvum* + *C. lineolata;*
Camponotus pennsylvanicus + *F. sanguinea* + *S. fulvum* + *C. lineolata; etc.*

In these colonies "there is a close affiliation of ants of different species. Those of different subfamilies sometimes lick one another. Introduced young is carried about and taken care of without regard to its origin. Ants of one genus accept regurgitated food from those of another genus."

To sum up, in conclusion, it would seem that the slave-making, or dulotic, instincts of *sanguinea* may be resolved into a number of instincts which are unique in their combination, but as single elementary activities are of much more universal occurrence and hence of greater phylogenetic antiquity and importance. These instincts fall into three groups:

---

[1] Artificial Mixed Nests of Ants. Biol. Bull., V, No. 6, Nov., 1903, pp. 320–325.

1. The *discriminative parasitic instincts* of the queen. These may have originated by the "method of trial and error" from a condition of more indiscriminate parasitism.

2. The *discriminative kidnapping instincts* of the workers. These, too, have probably developed out of indiscriminative activities of a similar nature undertaken, like those of *Eciton*, for purely predatory purposes, through the influence of and in conjunction with the discriminative parasitic instincts of the female.

3. The *threptic instincts* which are apparently universal among ants and depend on simple conditions that readily permit of the survival, hatching, and rearing of alien species.[1]

If this interpretation of the dulotic instincts is correct, we must admit that dulosis has grown out of temporary social parasitism and tends towards a form of permanent and abject social parasitism through such a series as is represented successively by *Polyergus*, *Strongylognathus huberi*, *S. testaceus*, *Anergates*, etc. This interpretation is in part at variance with that of previous authors, who suppose that dulosis has grown out of the "abnormal mixed colonies." In so far as these colonies are regarded as fortuitous alliances of ants belonging to different species, the interpretation is incorrect. I have shown [2] very good reasons for supposing that such "abnormal mixed colonies" are in reality normal cases of temporary social parasitism, and only as such would I admit that they represent an initial stage in the development of dulosis. While it will be necessary, therefore, to abandon the older interpretation in so far as it relates to the phylogenetic origin of dulosis, we may still accept it in so far as it relates to the developments that are supposed to have succeeded the *sanguinea* stage.

I am well aware of certain shortcomings in the interpretation offered in the preceding pages. A particularly weak point is our ignorance of the first beginnings of the *sanguinea* colony. The interpretation I have given, however, has the very great advantage, even as an hypothesis, of avoiding unnecessary psychological assumptions and drawing into the discussion any instincts that are not well known and readily observable in many ants besides the dulotic species. It is certain that these instincts, both individually and in combination, are subject to great variation in intensity, especially in our American ants, many of which, like our species of *Formica*, seem to have emerged from a mutation period only within comparatively recent time. That these variations are subject to modification and development through natural selection is an opinion to which I incline, and against which I fail to see that Wasmann has adduced any valid arguments whatsoever. I need not waste many words on his "innere gesetzmässig wirkende Ursachen," to which he resorts whenever it suits his convenience. Such expressions are merely scholastic formulæ, which in one sense may be regarded as obvious, in another as specious phrases that explain everything, while they demonstrate nothing.

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[1] I have not considered the obscure and interesting question of the absence of the sexual forms (males and females) of the auxiliary species in dulotic colonies, since the same condition obtains also in cases of temporary (*Formica consocians* + *incerta*) and in permanent social parasitism (*Anergates* + *Tetramorium*).

[2] A New Type, etc., *loco cit.*

56.39,1 M (114:74.7)
56.4,1 O (114:74.7)

Article II.—NOTICE OF A NEW CRINOID AND A NEW MOLLUSK FROM THE PORTAGE ROCKS OF NEW YORK.

By R. P. Whitfield.

Plates I–IV.

Among the many specimens of *Cyathocrinus ornatissimus* collected by Professor James Hall, at or near the town of Portland, on Lake Erie, and described and figured in the Geological Report of the Fourth District of the New York Geological Survey, 1843, p. 247, there are two specimens of a second and quite distinct species, which, though badly mutilated, are, I think, quite worthy of a distinct name and notice. The specimens lie on blocks of the same stone with fragments of the original species and among them, so that they have remained these many years undistinguished, but the species differs so remarkably in many particulars that it is a wonder it had not been seen before this late date.

The specimens lie on the stone with the anal side exposed and preserve several of the arm bases on the left side as they rest on the stone, a small portion of those on the right side and much of the anal area, with, on one, a portion of the base of the ventral sack. The following description gives the features of the species as far as can be ascertained.

In correspondence with Mr. Frank Springer in regard to these specimens he recommends the formation of a new genus for this new form, as he is satisfied there is no known genus now existing that will exactly correspond to its characters. I have therefore concluded to propose for its reception the name *Maragnicrinus*, from the Greek word *μάραγνα*, meaning a scourge or whip, in reference to the long, slender, whip-like arms, and *κρίνον*, a lily, with the following generic characters.

Maragnicrinus, gen. nov.

Generic description.—A dicyclic, inadunate, fistulate crinoid, having five infrabasals. Calyx obconical; posterior interradius composed of a large anal, a large radi-anal and one tube-plate within the calyx, and extended into a strong ventral sack. Articulating facets excavate, and not occupying the full width of the radials. Rays dividing but once into two main arm-branches, which are pinnulate.

The following description of the species gives the specific features as far as ascertained.

[*February, 1905.*]

Maragnicrinus portlandicus, sp. nov.

Body obconical, forming a conical cup somewhat wider at the top than the height to the base of the arms. Infrabasal plates (Wachsmuth and Springer) forming a shallow cup above the column; basal plates largest in the calyx, one at least of which is heptagonal, slightly wider than high or equal; first radials (brachials) much wider than high and supporting three arm plates in each of the posterolateral rays, the upper of which is a bifurcating plate giving origin to a very long, slender arm on each sloping face, which are simple above throughout their entire length of nearly or quite four inches (10 cm.). Arm plates very short, alternately longer and shorter on the opposite sides, the thicker edge being tentacle-bearing; tentaculæ very long, some of them being traceable for 2.8 cm., composed of many plates, longer than wide, and flattened on the face with a ridge along the centre of each giving a carinate appearance to the lines of tentaculæ. The tentacula of *P. ornatissimus* presents a similar feature, differing in this respect from Carboniferous crinoids. Anal plates large, two filling the space between the postero-lateral brachials, with three in the next series, above which they are small, transversely hexagonal and numerous.

The body plates are minutely radiatingly ridged and the plates of the arms are longitudinally corrugated.

Column round, composed of very short plates alternately thicker and thinner, and of larger and smaller discs, largest just below the calyx and gradually decreasing in size below. On one of the two specimens the column can be traced for a distance of over 22 cm.

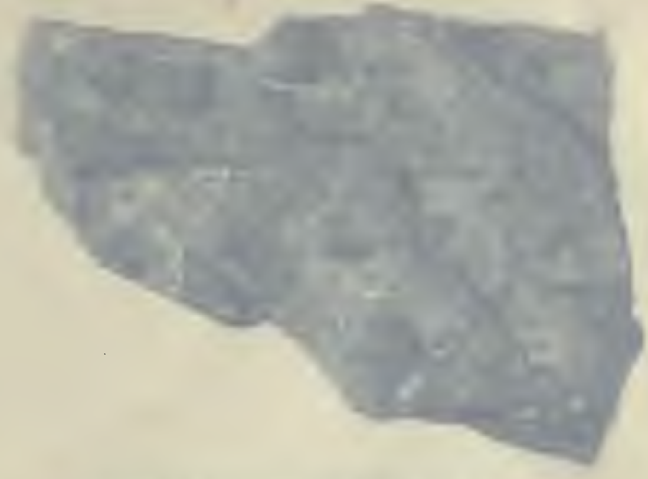
Geological position, in the Portage group at the town of Portland on Lake Erie, associated with *Cyathocrinus ornatissimus* Hall.

Associated with these specimens of crinoids and with those of *Cyathocrinus ornatissimus* there are many specimens of a *Lunulicardium*, a small bivalve shell usually occurring in pairs so placed as to indicate a union of the two shells by a connecting hinge ligament, as they are found generally back to back as if imbedded in the matrix while the valves were still united. The species is entirely different from any of those heretofore described, being smooth on the surface, quite ventricose, with strongly incurved beaks and a profoundly excavated lunule. Consequently I have considered it as forming a new genus and have described it below as *Onychocardium*, in consideration of its claw-like beak, which feature is partly produced by the deeply excavated lunule.

Onychocardium, gen. nov.

Shell bivalve, small, resembling *Lunulicardium* of Munster in its general form and truncated anterior end. Beaks sharp, pointed, and strongly incurved, the lunule deeply and profoundly excavated. Surface smooth or destitute of radii, unlike most of the group. Internal features and hinge unknown, valves presumably united by an external ligament.

Geological position, Portage limestone.



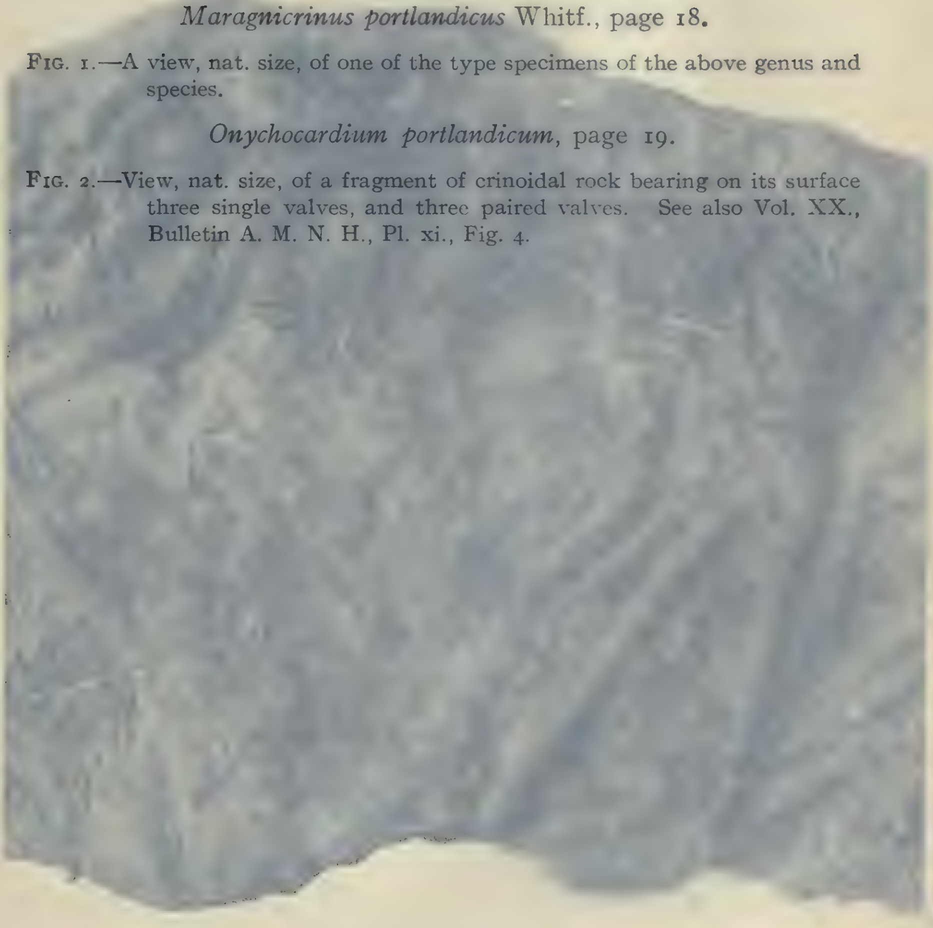
EXPLANATION OF PLATE I.

Maragnicrinus portlandicus Whitf., page 18.

FIG. 1.—A view, nat. size, of one of the type specimens of the above genus and species.

Onychocardium portlandicum, page 19.

FIG. 2.—View, nat. size, of a fragment of crinoidal rock bearing on its surface three single valves, and three paired valves. See also Vol. XX., Bulletin A. M. N. H., Pl. xi., Fig. 4.



1. MARAGNICRINUS [illegible]

2. ONYCHOCARDIUM [illegible]

[illegible] portlandicus, sp. nov.

Body [illegible] forming a conical cup somewhat wider at the top than the height to the base of the arms. Infrabasal plates (Wachsmuth and Springer) forming a shallow cup above the column; basal plates largest in the calyx, one at least of which is heptagonal, slightly wider than high or equal; first radials (brachials) much wider than high and supporting three arm plates in each of the [illegible] rays, the upper of which is a bifurcating plate giving origin to a very long, slender arm on each sloping face which are simple above throughout [illegible] lengths of nearly or quite four inches (10 cm.). Arm plates very short, alternately longer and shorter on the opposite sides, the thicker edge being [illegible]; tentacles very long, some of them being traceable for 2.8 cm., composed of many plates, longer than wide, and flattened on the face with a ridge along the centre of each giving a carinate appearance to the lined [illegible]. The [illegible] of *P. ornatissimus* presents a similar feature, differing in this respect from [illegible] crinoids. Anal plates large, [illegible] filling the space [illegible] with three in the next series, above which they are [illegible] hexagonal and numerous.

The body [illegible] of the arms are longitudinally corrugated.

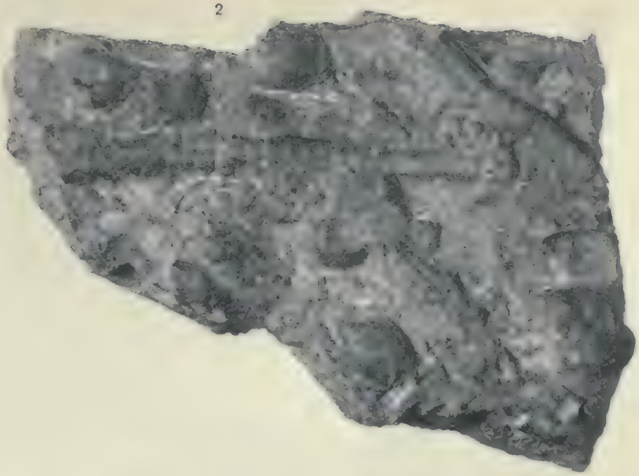
Column round, composed of [illegible] alternately thicker and thinner, and of larger and smaller ones [illegible] the calyx and gradually decreasing in size below. On [illegible] the column can be [illegible] for a distance of over 22 cm.

[illegible] with these [illegible] of crinoids and with those of [illegible] specimens of a [illegible] occurring in pairs [illegible] a union of the two shells by a connecting [illegible] are found generally back to back [illegible] while the valves were still united. The [illegible] different from any of those heretofore described [illegible] the surface quite ventricose, with strongly [illegible] profoundly excavated lunule. Consequently [illegible] as forming a new genus and have described it [illegible] of the [illegible] teeth, which [illegible] by the deeply excavated lunule.

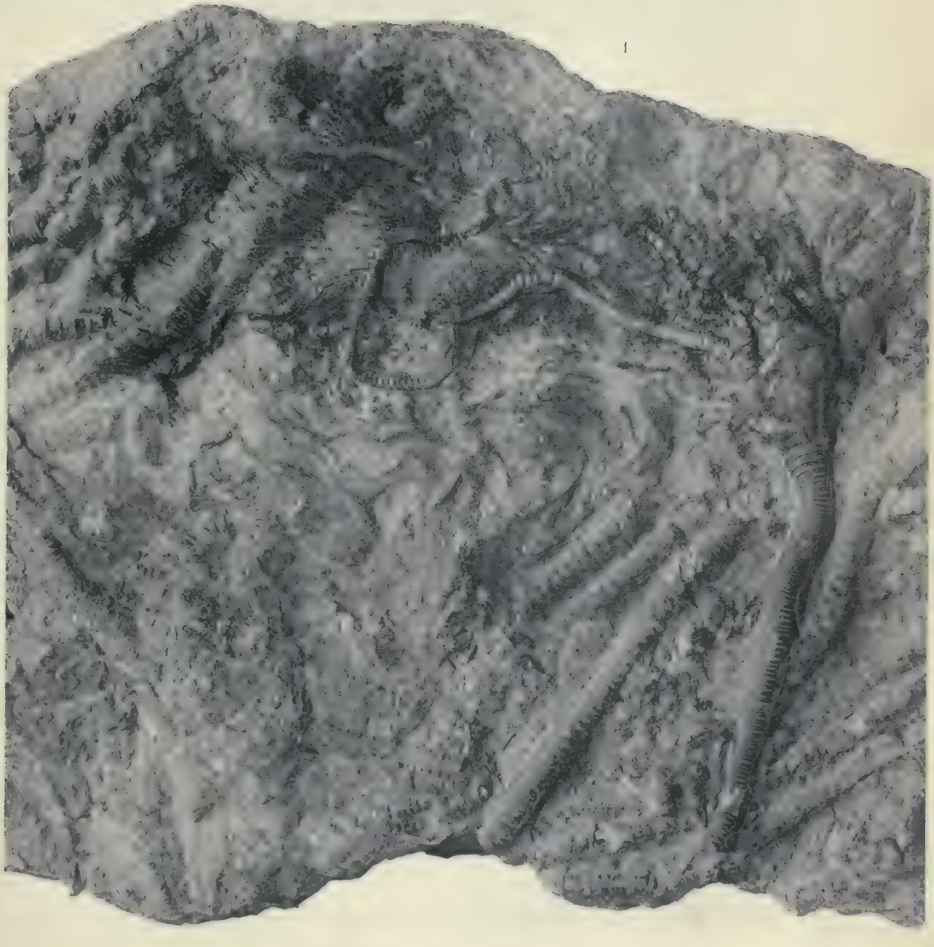
Onychocardium, gen. nov.

Shell bivalve, small, resembling *Luna[illegible]* in its general form and truncated anterior end. Beaks [illegible], the lunule deeply and profoundly excavated. [illegible] hinge unknown; valves [illegible]

2



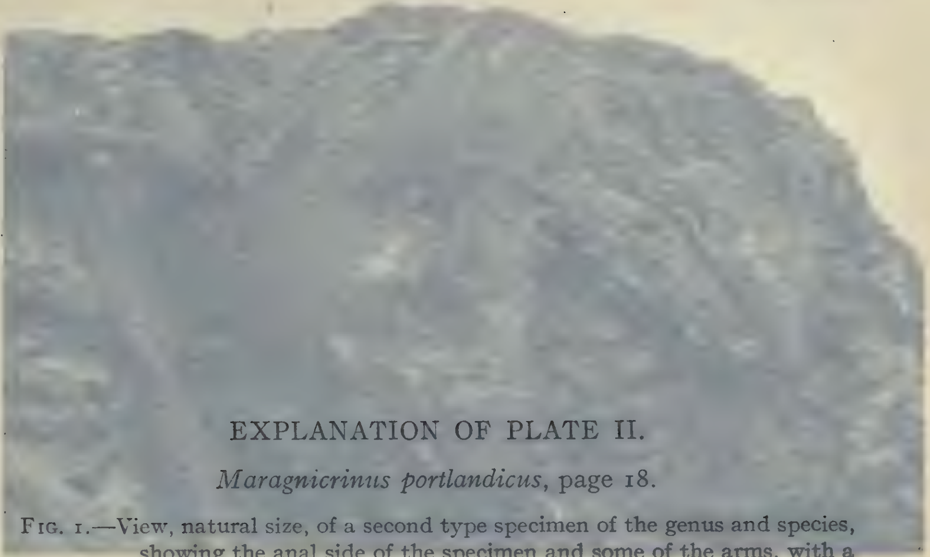
1

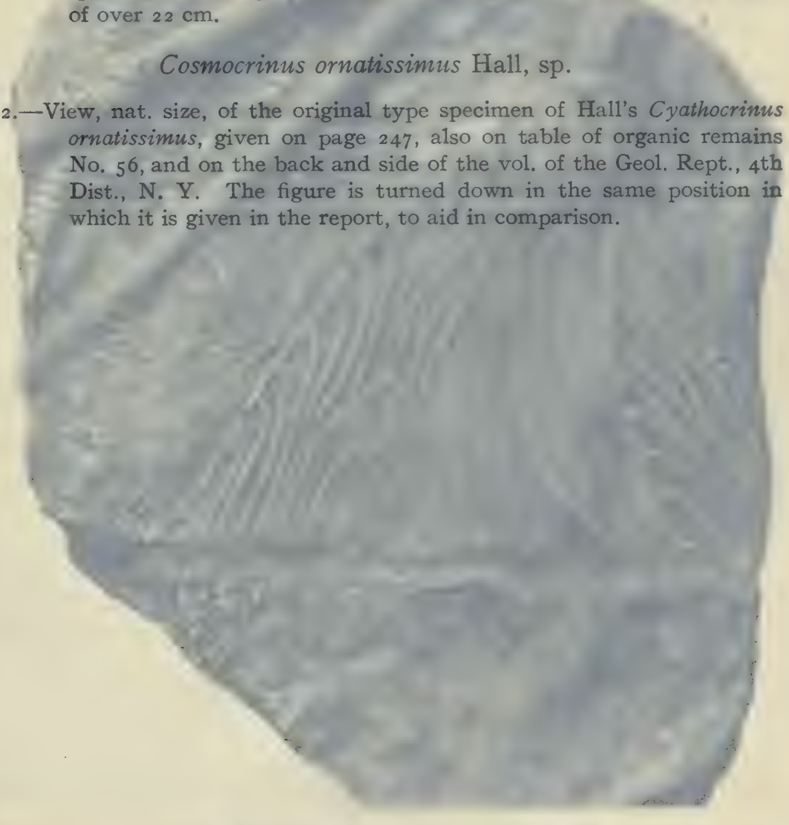


1, MARAGNICRINUS PORTLANDICUS *sp. nov.*

2, ONYCOCARDIUN PORTLANDICUM *sp. nov.*

HELIOTYPE CO., BOSTON.





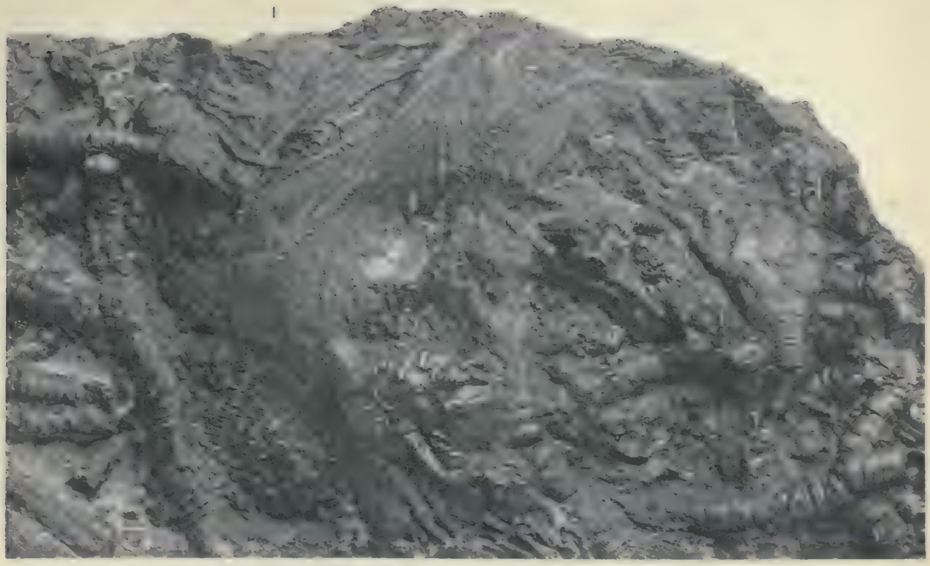
EXPLANATION OF PLATE II.

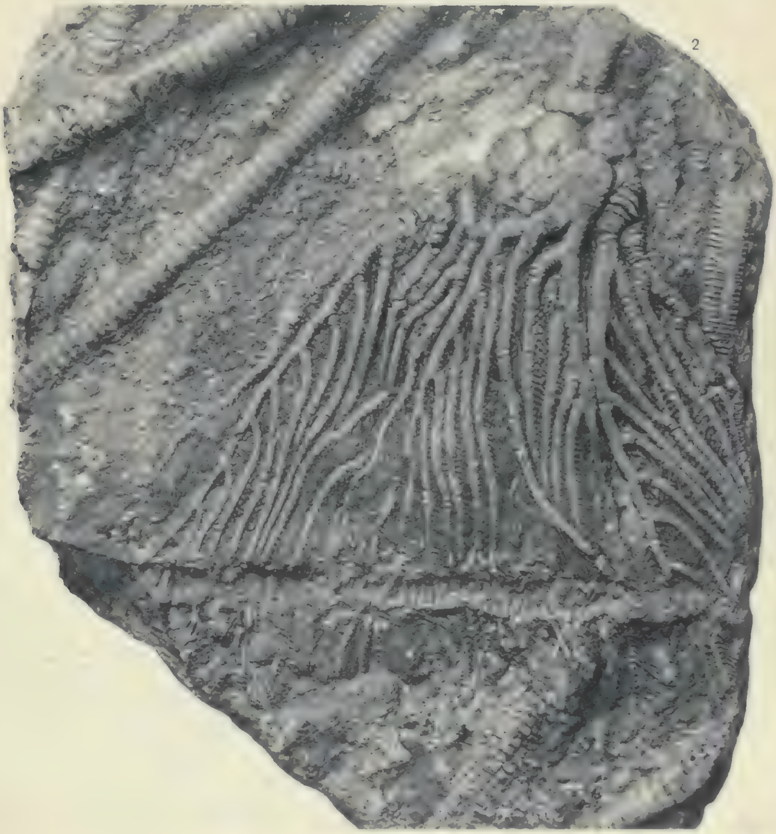
Maragnicrinus portlandicus, page 18.

FIG. 1.—View, natural size, of a second type specimen of the genus and species, showing the anal side of the specimen and some of the arms, with a fragment of *C. ornatissimus* above it with a portion of the ventral sack protruding on the lower left side. The column of this second specimen of *Maragnicrinus* can be traced on the stone for a distance of over 22 cm.

Cosmocrinus ornatissimus Hall, sp.

FIG. 2.—View, nat. size, of the original type specimen of Hall's *Cyathocrinus ornatissimus*, given on page 247, also on table of organic remains No. 56, and on the back and side of the vol. of the Geol. Rept., 4th Dist., N. Y. The figure is turned down in the same position in which it is given in the report, to aid in comparison.





1, MARAGNICRINUS PORTLANDICUS *Whitf.*

2, CYATHOCRINUS ORNATISSIMUS *Hall. sp.*

HELIOTYPE CO., BOSTON.

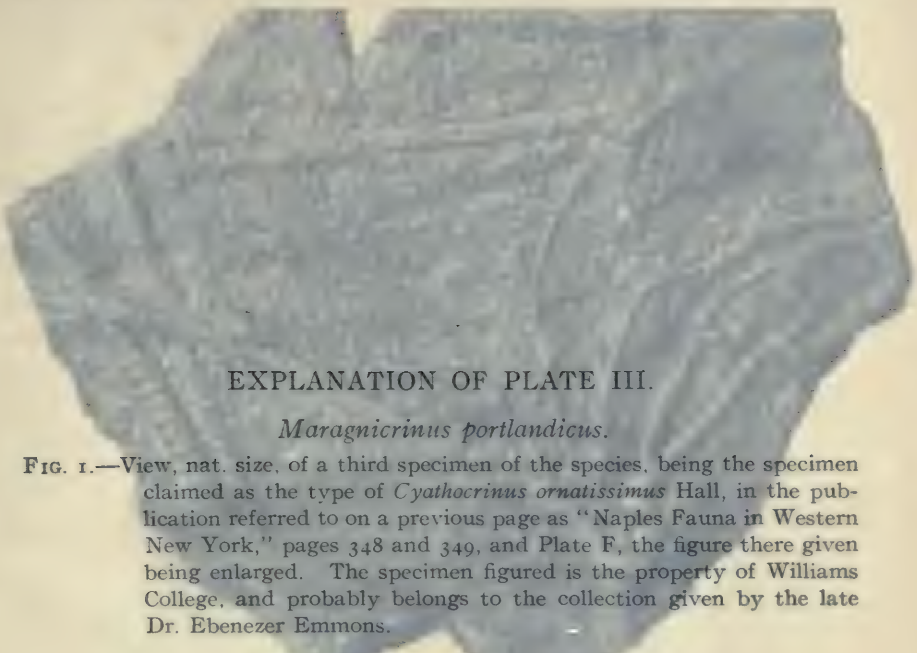
EXPLANATION OF PLATE III.

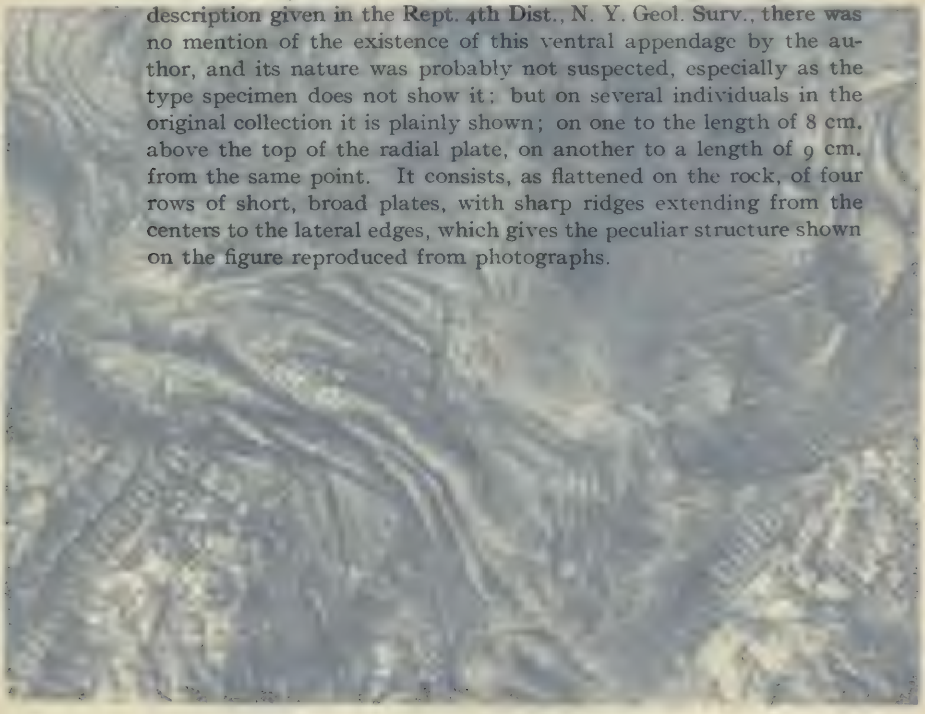
Maragnicrinus portlandicus.

FIG. 1.—View, nat. size, of a third specimen of the species, being the specimen claimed as the type of *Cyathocrinus ornatissimus* Hall, in the publication referred to on a previous page as "Naples Fauna in Western New York," pages 348 and 349, and Plate F, the figure there given being enlarged. The specimen figured is the property of Williams College, and probably belongs to the collection given by the late Dr. Ebenezer Emmons.

Cosmocrinus ornatissimus Hall, sp.

FIG. 2.—View, nat. size, of a specimen of *C. ornatissimus* showing the ventral sack with a portion of a second one. In the original figure and description given in the Rept. 4th Dist., N. Y. Geol. Surv., there was no mention of the existence of this ventral appendage by the author, and its nature was probably not suspected, especially as the type specimen does not show it; but on several individuals in the original collection it is plainly shown; on one to the length of 8 cm. above the top of the radial plate, on another to a length of 9 cm. from the same point. It consists, as flattened on the rock, of four rows of short, broad plates, with sharp ridges extending from the centers to the lateral edges, which gives the peculiar structure shown on the figure reproduced from photographs.

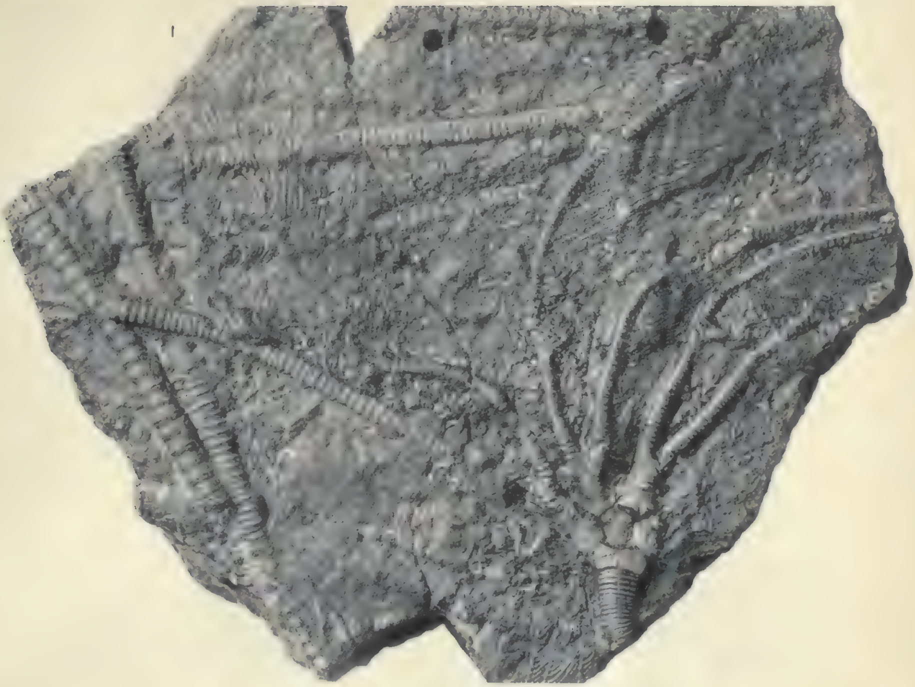




1. MARAGNICRINUS [illegible]

2. [illegible]

1



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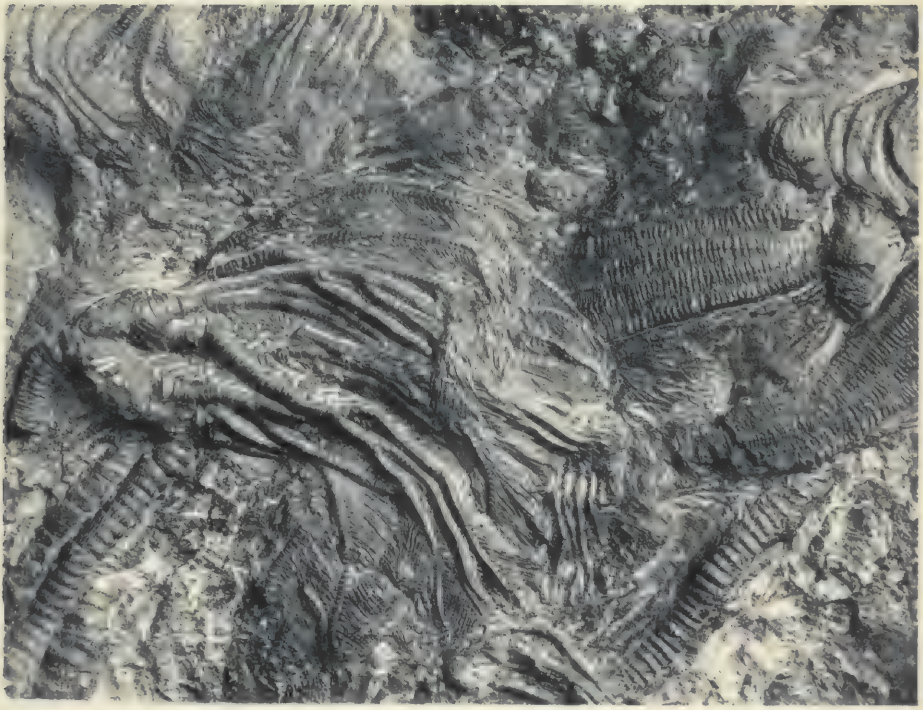
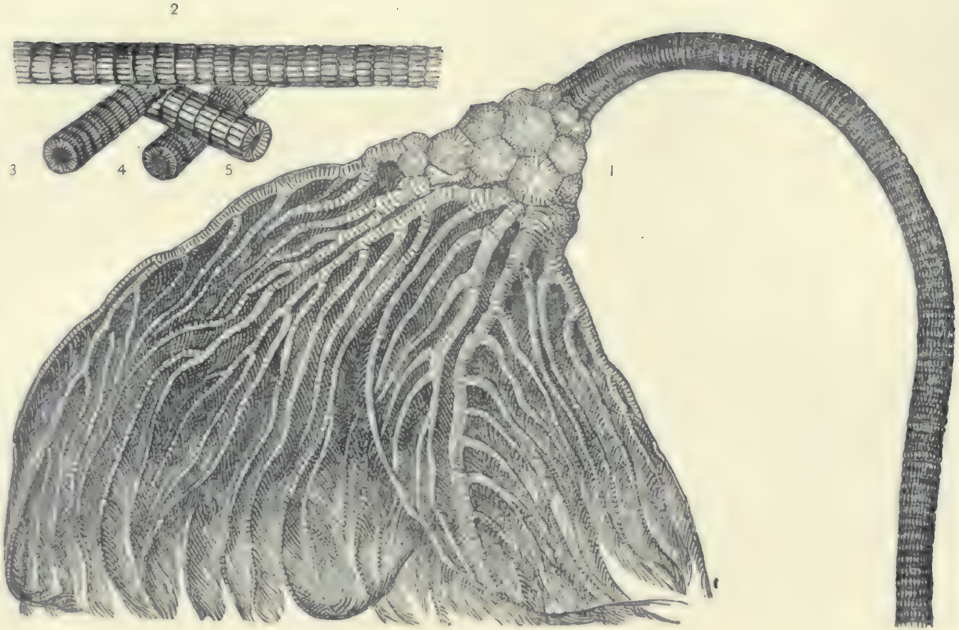


1, MARAGNICRINUS PORTLANDICUS *Whitf.*
2, CYATHOCRINUS ORNATISSIMUS *Hall. sp.*

HELIOTYPE CO., BOSTON.

EXPLANATION OF PLATE IV.

The plate is a reproduction of the original woodcut given by Prof. James Hall on page 247 of the Rept. on the 4th Dist. of the N. Y. Geol. Surv., 1843, which, it is stated in "Naples Fauna in Western New York," is a "composite design from many fragments." It will be readily seen from this figure and a comparison with Fig. 2 of Plate II in this publication, which is from a photograph, that there is nothing needed to produce the figure but the addition of the stem, for which there was ample material present when the figure was made. If one compares the details of the two figures it will be seen that it is more perfect in detail than nine tenths of the figures of natural objects made at the time (1841 to 1843).



Copy of original figure of Cyathocrinus ornatissimus *Hall*. Geol. Rept. 4th Dist. N. Y.

HELIOTYPE CO., BOSTON.

Onychocardium portlandicum, sp. nov.

PLATE I., FIG. 2.

Shell small, prominently convex, with a deeply excavated lunule, occupying the entire anterior end of the shell and bordered by a sharp ridge representing the anterior umbonal ridge of the valve, giving to the beaks of the shell a strongly curved, claw-like curvature, suggesting the generic name. Surface of the shell smooth, destitute of ornamentation.

Geological position and locality, in the Portage group at or near Portland Harbor, Lake Erie. Associated with the crinoid *Cyathocrinus ornatissimus* Hall.

CORRECTION OF A MISSTATEMENT.

While cataloguing the collection of *Cyathocrinus ornatissimus* of the Portage group in the collection of the Museum, my attention was called to a statement recently made in a work published under State authority at Albany, N. Y., entitled "Naples Fauna in Western New York," a beautiful and very valuable work supplementary to Hall's volumes of "Palæontology of the State of New York," regarding the type specimen of the above-named Crinoid which is in the possession of the Museum of Natural History at New York.

If the statement above alluded to should be taken literally as it reads, it would seem to throw strong doubt on the authenticity of the claim that the specimen in the Museum collection is really the type of the species as figured and described in the Geological Report of the Fourth District of New York, on page 247 of that work, and also on table 56, figures 1–5, as well as on the back or sides of the volume itself.

The statement above referred to is that the author "elicited from Professor Hall the statement that this drawing (given in the Fourth District Report, p. 247), was a composite design from many fragments, in which all the parts represented were not actually shown, and that some of this material on which the figure was based had been in the possession of a collector who subsequently made over his collection to Williams College." The author of the statement also figures, in connection with the statement, a specimen which he calls on the base of the plate "The type specimen" under the name *Scytalocrinus ornatissimus* Hall.

In order to correct this misstatement, and to show to the scientific world the true type of the species, I have had photographs taken of the type specimen in the Hall Collection, together with a reproduction by the same means of the figure given in the Fourth District Report of the Geological Survey of New York, that any one caring for the truth of the matter may convince himself of the facts of the case. I also give by the same photographic process a figure, natural size, of the specimen which is claimed in the above statement as the original type of the species *C. ornatissimus* Hall.

Early last spring (1904) I noticed among the specimens of *Cyathocrinus ornatissimus* in the collections here an imperfect specimen of another species entirely distinct from the original *C. ornatissimus* Hall (which, by the way, is not a *Cyathocrinus* or a *Scytalocrinus* as given in the work above mentioned, but is more probably a member of Jaekel's genus *Cosmocrinus*, which is based largely on Hall's *C. ornatissimus* and is a Devonian genus with the arms branching as in *C. ornatissimus* Hall) and which I now publish as *Maragnicrinus portlandicus*, and am convinced that the specimen stated by the author of the work above referred to as the type of *C. ornatissimus* is a third specimen of this new genus and species.

56.9,32 E (1181:78.3)
56.9,735 H (1181:78.3)

Article III.—NOTICE OF TWO NEW GENERA OF MAMMALS FROM THE OLIGOCENE OF SOUTH DAKOTA.

By W. D. Matthew.

Among the collections made by Mr. Albert Thomson for the American Museum last summer are skulls and fragmentary skeletons of a rodent and a small artiodactyl clearly distinct from any known genera.

Eutypomys,[1] gen. nov.

Dentition $I\frac{1}{1}$, $P\frac{2}{1}$, $M\frac{3}{3}$. Molars and fourth premolar subhypsodont, quadrate in outline, with complicated surface pattern of numerous small cement lakes. Skull rather elongate, with moderately wide and slender arches, brain-case small, sagittal crest low, no postorbital process. Infraorbital foramen quite small, the root of the arch concave externally, with a ledge above and in front of it for attachment of masseter, as in Sciuridæ and Castoridæ. Fore and hind limbs moderately long, tibia and fibula separate, fibulocalcanear contact slight or absent. Pes pentadactyl, the first digit small, divergent, or somewhat opposable, second digit quite slender, third, fourth, and fifth moderately stout and of equal size. Facet of fifth metatarsal on cuboid entirely lateral, the distal facet of the cuboid resting on mt. IV exclusively.

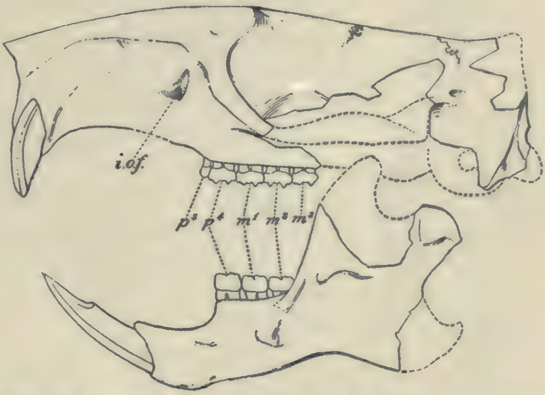


Fig. 1. *Eutypomys thomsoni.* Side view of skull and jaws, natural size. Type specimen No. 12254. Oreodon Beds, South Dakota.

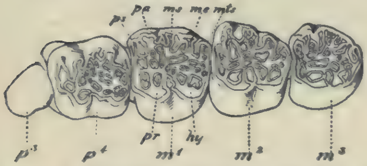


Fig. 2. *Eutypomys thomsoni.* Crown view of upper teeth, three times natural size. No. 12255. Oreodon Beds, South Dakota.

The tooth pattern is difficult to interpret, but appears to be based upon the following elements: There is a pair of internal crescents (protocone and hypocone), each connected by a ridge with the primary external cones (paracone and metacone). In addition are anterior and posterior external cusps (parastyle and metastyle), each prolonged inward in cingular ridges joining the inner crescents, and a median external cusp (mesostyle), prolonged inward in a ridge to the centre of the tooth. All these transverse ridges, as well as the internal crescents, have irregular cross-ridges on their surface, excepting on the borders of the crown. On wear, the subsidiary crests promptly join, and the valleys between them are converted into small isolated lakes, apparently filled by cement, although there is little trace of cement on the external borders of the crown. There are eighteen of these lakes on m^1 of the type, but their number and form would apparently change much with wear.

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[1] Derivation: εὖ, well; τύπος, pattern; μῦς, mouse.

Eutypomys is a somewhat difficult genus to place. The dental formula is that of Ischyromyidæ and Sciuridæ. In the forward extension of the origin of the lateral masseter above and beyond the infraorbital foramen, it corresponds with Sciuridæ and Castoridæ, and differs from Ischyromyidæ, in which the origin of this muscle is entirely behind the infraorbital foramen, an arrangement preserved in the Haplodontidæ, *Meniscomys* and *Haplodontia*, and in the Mylagaulidæ. The absence of postorbital processes and strongly constricted postorbital region corresponds with Ischyromyidæ, Haplodontidæ, and Castoridæ, but differs from Sciuridæ. The teeth suggest those of *Steneofiber* in their quadrate outline and general character, but not at all in details of pattern. The pes, with its axis of symmetry passing through the fourth digit, the first and second much reduced, indicates relationship to *Castor*, where the same digital development occurs, although the proportions of the foot are different.

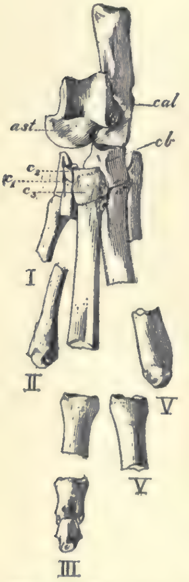

Fig. 3. Hind foot of *Eutypomys*. Natural size. No. 12255.

On the whole, it seems necessary to refer this interesting rodent to the Castoridæ, with which it has in common: (1) two peculiar progressive characters, the quadrate molars with tendency to form small enamel lakes on the surface, and the reduction of digits I and II of the pes; (2) several progressive and several primitive characters shared by one or another of the remaining Sciuroid families; and from which it differs in the primitive character of retention of the third upper premolar.

Eutypomys thomsoni, sp. nov.

The present species is about the size of *Ischyromys typus*. It is based upon two specimens, No. 12254, type, a skull and jaws, with various fragments of the skeleton, and No. 12255, paratype, upper jaws, hind foot, and other fragments. Both specimens were found in the Lower Oreodon Beds of the White River formation, on Quinn Draw, Cheyenne River, S. Dakota.

Heteromeryx,[1] gen. nov.

This name is applied to a small ruminant about the size of *Protoceras*, from the Titanotherium Beds of the White River formation in South Dakota. It is represented by a skull with a considerable part of the skeleton, including most of the fore feet and parts of the hind feet. Other specimens from the same horizon, consisting of incomplete jaws, teeth, etc., are doubtfully referred.

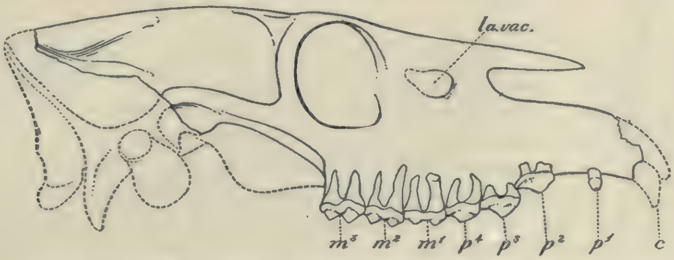

Fig. 4. *Heteromeryx dispar.* Skull, side view, one half natural size. Type specimen No. 12326. Titanotherium Beds, South Dakota.

Char. gen.—Skull rather short, orbits complete behind, situate over the posterior molars, muzzle elongate, nasals considerably reduced. Teeth very short crowned, molars with heavy internal cingula and rudimentary mesostyle. Four premolars, the first small, simple, with long diastemata before and behind it, the others much as in *Leptomeryx*. Ulna with well-developed shaft, coossified with radius along its entire length. Manus functionally tetradactyl, with four separate digits as in *Leptomeryx*. Magnum and cuneiform fused. Distal end of fibula separate from tibia; shaft a small vestigial spine. Pes didactyl, with separate metatarsals, cuboid and navicular distinct, ecto- and meso-cuneiform fused. Ungual phalanges short and compressed.

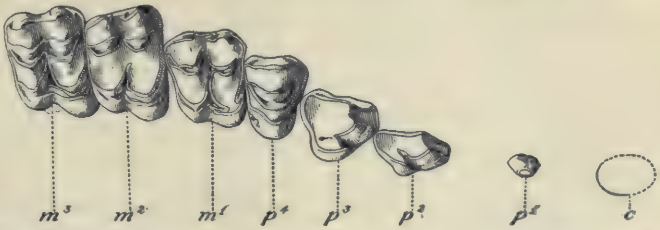

Fig. 5. *Heteromeryx dispar.* Upper teeth, natural size. Type specimen No. 12326.

Heteromeryx dispar, sp. nov.

Char. spec.—Size somewhat less than *Protoceras celer;* a little larger than "*Leptomeryx*" *mammifer* Cope, which may prove to belong to this or a closely allied genus rather than to *Leptomeryx*. Type No. 12326, skull and fragmentary skeleton from the Middle Titanotherium Beds on Indian Creek, Cheyenne River, S. Dakota.

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[1] Derivation; ἕτερος, different; μέρυξ, ruminant.

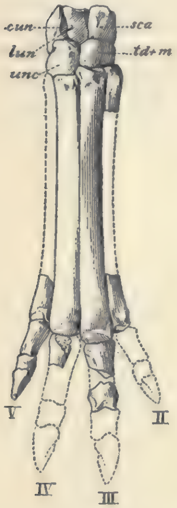

Fig. 6. Fore foot of *Heteromeryx*. One half natural size. Type specimen, No. 12326.

The Hypertragulidæ, to which this genus is referred, are distinguished from all other American ruminants by the combination of functionally tetradactyl manus with didactyl pes. There are five very distinct genera in the White River formation. They have the following characters in common:

Muzzle slender anteriorly, with long diastemata between canines and molar-premolar series (p$\frac{2}{2}$, m$\frac{3}{3}$). Lower canine incisiform. Premolars elongate or reduced but less compressed than in Camelidæ. Paracone of upper molars convex, metacone flat or convex externally, mesostyle present or absent. Manus tetradactyl, the magnum and trapezoid consolidated (except in *Protoceras*). Fibula vestigial, the distal rudiment separate or consolidated with tibia. Pes didactyl, lateral toes extremely slender or reduced to splints, median metatarsals separate (except in *Leptomeryx*). Cuboid and navicular consolidated (except in *Heteromeryx* and sometimes in *Protoceras*). Ecto- and meso-cuneiforms consolidated. Keels on distal ends of metapodials confined to under surface.

The principal distinctions between the five White River genera are:

	Protoceras.	*Heteromeryx.*	*Leptomeryx.*	*Hypertragulus.*	*Hypisodus.*
Skull:	Elongate.	Intermediate.	Intermediate.	Short.	Very short.
Orbits:	Behind molars.	Over m^{2-3}.	Over m^{2-3}.	Over m^{2-3}.	Over m^{2-3}.
Recession of anterior nares:	Extreme.	Moderate.	None.	None.	Moderate.
Bullæ:	None.	?	Small.	Larger.	Very large.
Upper Incisors:	Absent.	(Probably absent in all.)			
C^1:	Large, falciform.	Small.	Very small.	Caniniform, rather small.	Unknown.
P^1:	Small.	Small, one-rooted.	Absent.	Large, two-rooted.	Unknown.
P_1:	Small, spaced.	?	Small, spaced.	Caniniform.	Incisiform.
Premolars:	Elongate.	Complex.	Complex.	Simpler.	Simpler.

	Protoceras.	*Heteromeryx.*	*Leptomeryx.*	*Hypertragulus.*	*Hypisodus.*
Molars:	Very brachydont.	Very brachydont.	Brachydont.	Brachydont.	Hypsodont.
Mesostyle:	Strong.	Small.	Strong.	Absent.	Absent.
Ulna and radius:	Separate.	Coössified.	Separate.	Coössified.	Coössified.
Tibia and fibula:	Separate.	Separate.	Separate.	Coössified.	Coössified.
Navicular and cuboid:	Variable.	Separate.	Coössified.	Coössified.	Coössified.
Metatarsals:	Separate.	Separate.	Coössified.	Separate.	Separate.

From the above table it may be seen that the new genus is partly intermediate between *Leptomeryx* and *Protoceras*, retaining several primitive characters of both. It confirms Professor Scott's opinion that *Protoceras* is related to the Hypertragulidæ and should be placed in the same family. Except for the coössified ulna and radius we might regard *Heteromeryx* as a possible ancestor of *Protoceras;* it comes from a much older horizon, the middle Titanotherium beds, corresponding to the lowest Oligocene; while *Protoceras* is found only in the stream-channel beds at the top of the White River formation, and is uppermost Oligocene or even perhaps Lower Miocene. But it is much more probable that the five genera are independent branches.

The premolars recall those of *Leptomeryx*, but the molars resemble more nearly those of *Protoceras* except in the form and position of the heavy internal cingula. The nares have neither the almost terminal position in *Leptomeryx* and *Hypertragulus* nor the great recession seen in *Protoceras*, and there is no sign of the bony bosses that are so conspicuous a feature of the male skull in *Protoceras*. The orbits have the normal position above the posterior molars, whereas in *Protoceras* they are situated entirely behind the molar series.

The position of the Hypertragulids is variously estimated by different authors. By Leidy and Cope they were regarded as related to the Tragulines; Scott regards them as representing a series of offshoots from the camel phylum, of varying divergence; and Schlosser has recently advanced the view that they represent approximately the ancestral stock of the Sivatherines and gazelles. The present writer is unable to accept any of these views, but regards the group as an entirely independent offshoot of the primitive ruminant stock, without especially near relations to any other group, and without any known descendants in the Miocene or later epochs.

The tendency to podial coössification is a marked feature, allying them with Tragulids and Pecora, and one that never occurs in camels, although these have the metapodial reduction much more advanced. The wide difference in evolution between fore and hind feet separates them from all other groups. The fore foot, however, is not known in *Hypertragulus* and *Hypisodus*, which are only provisionally associated with the three more completely known genera. In many respects they are strikingly like the primitive camels, but the resemblance is chiefly in archaic characters and would unquestionably be shared by all primitive ruminants, of no matter what group. The resemblances to *Tragulus* are also marked, especially in *Hypertragulus* and *Hypisodus*, but these, again, must be regarded as chiefly the retention of primitive characters, except in the two genera named, in which the resemblance in pattern of the teeth may indicate a closer relationship. It is quite probable that the Uinta selenodonts are not far removed from the primitive ruminant stock; they certainly appear to bridge the gaps between Hypertragulidæ, camels, and oreodonts, but it does not at all follow that the Old World ruminants are not derived from the same primitive stock toward which all the American types seem to be tending as we trace them back into the Eocene.

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Article IV.—NOTES ON THE DEVONIAN "PLACODERM," *DINICHTHYS INTERMEDIUS* NEWB.

By L. Hussakof.

Plate V.

Since the description of *Dinichthys* by Professor Newberry in 1873,[1] remains of this "Placoderm" have been collected, more or less abundantly, at various Devonian localities in Europe as well as in North America. Unfortunately, however, the fossils have usually proved fragmentary and even the better specimens in many cases are represented only by detached plates. It has been, therefore, through the association of parts of several individuals that our best understanding of the characters of the genus has been obtained. On the other hand, the fact must be sadly recorded that some of the best material from the classic Ohio localities has been lost through the vagaries of enthusiastic local collectors, who would detach from a concretion only the larger plates, casting out all other parts, and then shuffle together the detached elements so that it is well nigh impossible to bring together again the parts from the same concretion.

Little is known, therefore, of *Dinichthys* as restored from parts of unquestionably the same individual. For this reason, my attention has been directed to a conspicuous exception in the way of Dinichthyid material in the shape of a slab[2] containing associated plates which I have had the opportunity of examining in the American Museum of Natural History. This slab, it may be mentioned, exhibits the majority of the body plates belonging to a single individual of *D. intermedius.* The cranial shield is wanting, but data for its proportions may be deduced from the measurement of related parts, as well as from comparisons of the preserved plates with separate crania belonging to the same species. Dr. Eastman, who some years ago studied this slab for another purpose, declared it "valuable for furnishing comparative measurements of the different bones."[3]

As shown in Plate V, the slab presents for examination ten readily recognizable plates scattered over its surface, and three or four fragmentary elements of doubtful position. They do not retain their natural relations but are wrenched out of place, dorsal and ventral plates being commingled, some partly overlying and concealing others. They seem not to have settled into their present places naturally upon decomposition, but rather to have been tossed by violence; but as to the nature of a disturbance that could so destroy the calm of the Cleveland Sea we can draw no conclusion.[1] The various plates as they appear in the slab will first be described.

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[1] Report of the Geol. Survey of Ohio, Vol. I.

[2] Newberry Collection, No. 195. Locality, Cleveland Shales, Ohio.

[3] On the Relation of Certain Plates in the Dinichthyids, with Descriptions of New Species. Bull. Mus. Compar. Zoöl. Harvard, Vol. XXXI, 1897, No. 2, p. 21.

Dorso-Median (Plate V, D M). This is the largest and most conspicuous piece in the slab — the shovel-shaped plate lying on the right hand side. It here rests on its back, which is arched from side to side. On the right, it is broken off in nearly a straight line and the fragment appears to be lost (restored in the plate).

Antero-Dorso-Lateral (A D L). This plate, the right, appears beside the dorso-median and partly overlies it. The visceral aspect is uppermost.

Postero-Dorso-Lateral (P D L^1). This is the somewhat triangular plate, lying immediately above and to the left of the antero-dorso-lateral, and exposing its visceral face. Its fellow is recognized in the remarkably well-preserved triangular plate near the bottom of the slab (P D L^2).

Antero-Ventro-Lateral (A V L). This may be recognized in the plate lying to the left and partly beneath the postero-dorso-lateral. The one preserved is from the right side of the animal: it exposes the outer surface.

"*Mandibles*" (Mn). The antero-ventro-lateral partly overlaps one of the "mandibles" — that from the right side, exhibiting the visceral aspect. To the right is the counterpart of the anterior half of its fellow.

"*Premaxillary*" (Pxm). Near the "mandibles," appears the right "premaxillary." It lies on its side, the visceral aspect being turned outward.

Antero-Ventro-Median (A V M). Below the "premaxillary" lies an elongated triangular element, the antero-ventro-median. It is a small plate which in its natural position was wedged in anteriorly between the two antero-ventro-laterals of the plastron. This specimen differs, in this respect, therefore, from *D. terrelli*, in which the antero-ventro-median fuses with the postero-ventro-median, — the latter character, however, may be but a symptom of age.[2]

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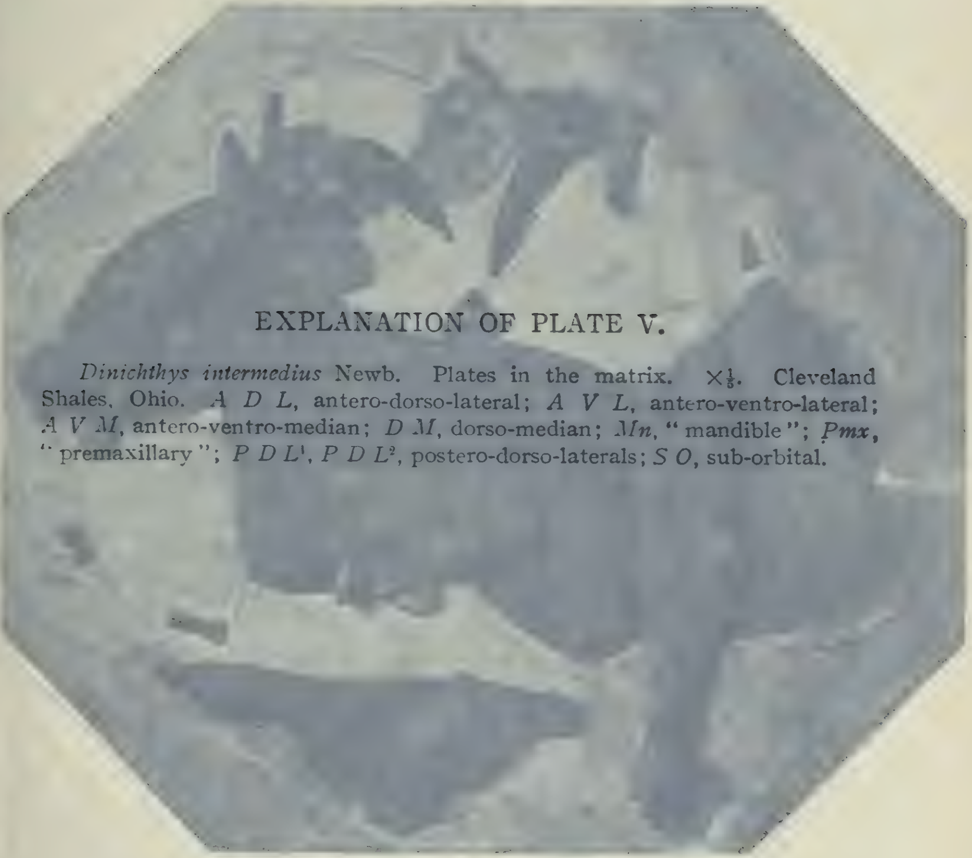
[1] For tranquility and general conditions of the seas in which the Cleveland Shale was deposited, *vide*, Bashford Dean: The Preservation of Muscle-Fibres in Sharks of the Cleveland Shale. Amer. Geologist, Vol. XXX, 1902; espec. pp. 277–278.

[2] For a discussion of this subject, *vide:* Bashford Dean: On the Vertebral Column, Fins and Ventral Armoring of Dinichthys. Trans. N. Y. Acad. Sc., Vol. XV, 1895, pp. 157–163, plate vii. Chas. R. Eastman: On the Relations of Certain Plates in the Dinichthyids, etc., Bull. Mus. Compar. Zoöl. Harvard, Vol. XXXI, 1897, No. 2. A. A. Wright: New Evidence upon the Structure of Dinichthys (Abstract). 5th Ann. Rept. Ohio Acad. Sc., 1897.

EXPLANATION OF PLATE V.

Dinichthys intermedius Newb. Plates in the matrix. ×⅛. Cleveland Shales, Ohio. *A D L*, antero-dorso-lateral; *A V L*, antero-ventro-lateral; *A V M*, antero-ventro-median; *D M*, dorso-median; *Mn*, "mandible"; ***Pmx***, "premaxillary"; *P D L*¹, *P D L*², postero-dorso-laterals; *S O*, sub-orbital.



DINICHTHYS INTERMEDIUS *Newb.*

concealing [illegible]. They seem not to have settled into their present places naturally upon decomposition, but rather to have been tossed by violence; but as to the nature of a disturbance that could so destroy the calm of the Cleveland Sea we can draw no conclusion.[1] The various plates as they appear in the slab will first be described.

Dorso-Median (Plate V, D M). This is the largest and most conspicuous piece in the slab — the shovel-shaped plate lying on the right-hand side. It [illegible] on its back, which is arched from [illegible]. On the right, it is broken off in nearly a straight line and [illegible] appears to be lost [illegible] the plate).

Antero-Dorso-Lateral (A D L). This plate, the right, appears beside the dorso-median and partly overlies it. The [illegible] is uppermost.

Postero-Dorso-Lateral (P D L¹). This is the somewhat triangular plate, lying immediately above and to the left of the antero-dorso-lateral, and exposing its [illegible] face. Its fellow is recognized in the [illegible] well preserved triangular piece near the bottom of the [illegible] (P D L²).

[illegible]

"Mandibles" (Mn). The a[illegible] one of the "mandibles" [illegible] aspect. To the right is the counterpart of [illegible] of its fellow.

"Premaxillary" (Pxm). [illegible] the "mandibles," appears the right "premaxillary." It lies [illegible] the visceral aspect being turned outward.

Antero-Ventro-Median (A V M). Below the "premaxillary" lies an elongated triangular element, the antero-ventro-median. It is a small plate which in its natural position was wedged in anteriorly between the two antero-ventro-laterals of the plastron. This specimen differs in this respect, therefore, from [illegible], in which the antero-ventro-median fuses with the postero-ventro-median, — the latter character, however, may be but a [illegible] of age.[2]

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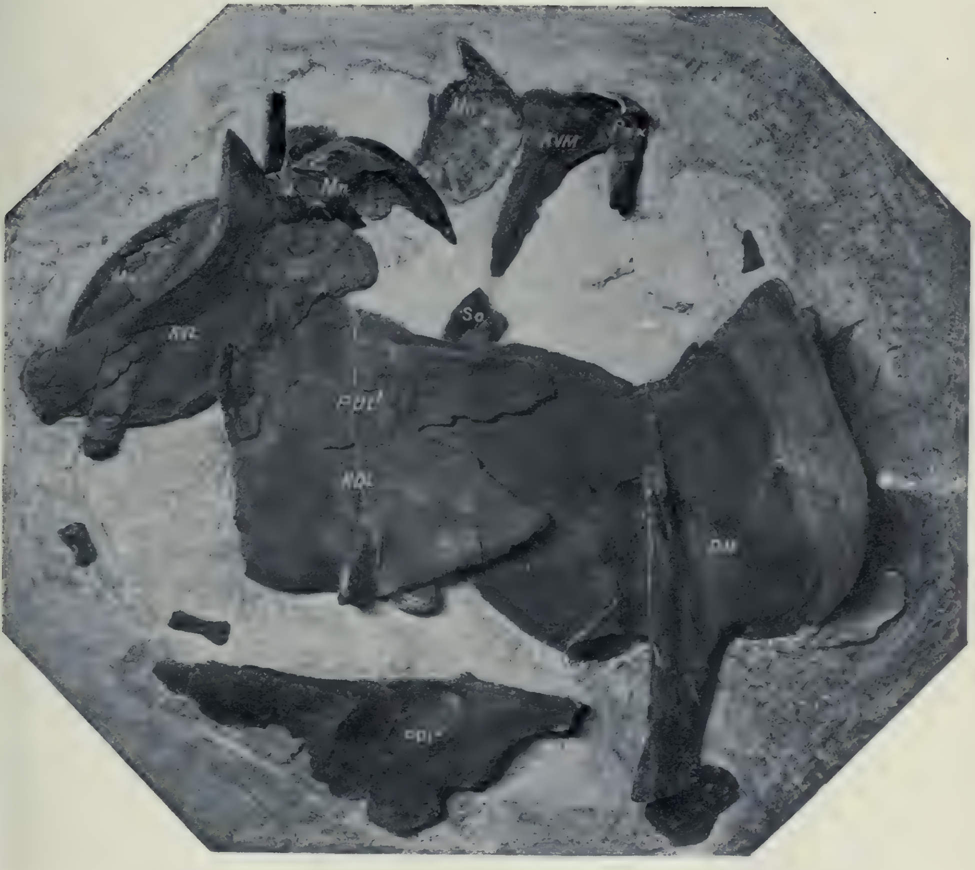
[1] For tranquility and general conditions [illegible] vide, Bashford Dean, The Preservation of [illegible] Amer. Geologist, Vol. XXX, 1902; espec. pp. [illegible]

[2] For a discussion of this subject see [illegible] Ventral Armoring of Dinichthys. Trans. N. Y. Acad. Sci., Vol. XV, [illegible] Chas. R. Eastman, On the Relations of [illegible] Zoöl. Harvard, Vol. XXXI, 1897, No. 2 [illegible] Dinichthys (Abstract) [illegible] Ann. Rept. Ohio [illegible]


Mn
IVM
Mn
So
PDL'
MDL

Dinichthys intermedius *Newb.*

Sub-Orbital (S O). One other plate may be identified—the one occupying the center of the slab,—the right sub-orbital. It is, however, so completely covered over by the postero- and the antero-dorso-laterals, that only a small corner projects on either side of them.

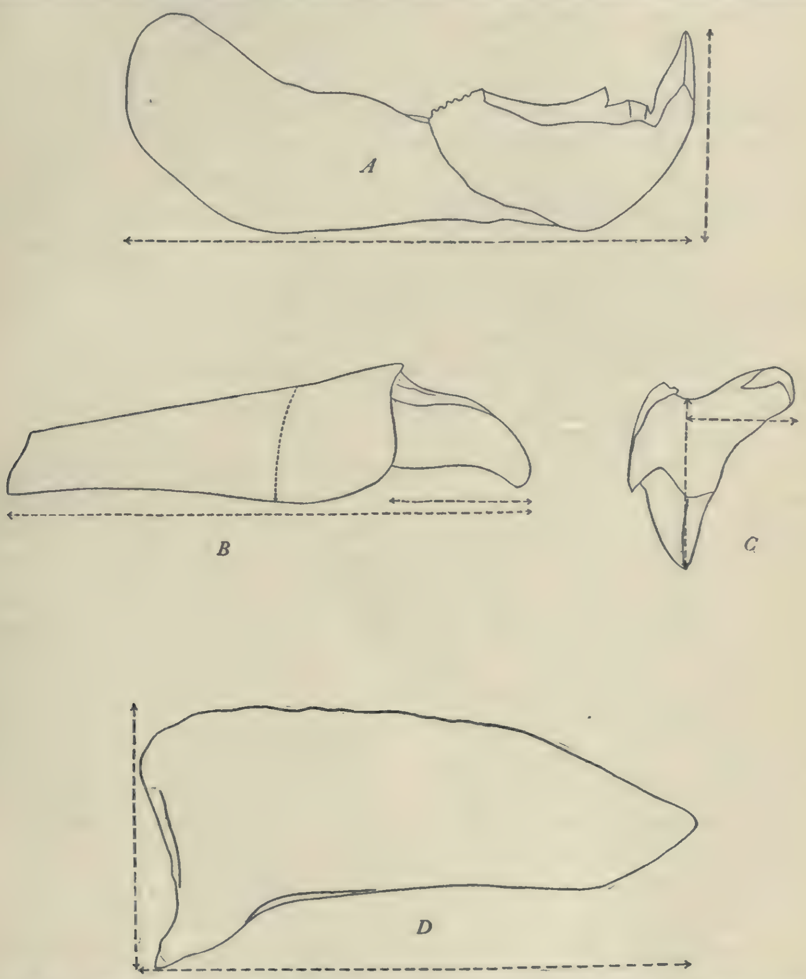


Fig. 1. Diagrams illustrating the mode of measurement of Dinichthyid plates. All *D. intermedius*. Somewhat less than one fourth natural size.
A.—Right "mandible"; from without.
B.—Dorso-median; side view.
C.—Right "premaxillary"; inner view.
D.—Right antero-ventro-lateral; from without.

Thus it is seen that most of the body plates of a single individual of *Dinichthys* are here preserved. By the careful measurement of these, and by inferences based upon their apposing surfaces to give approximate estimates of the sizes of the plates missing, we may arrive at tolerably accurate data for the proportions of most of the exoskeletal elements. But before recording the measurements, some explanation is necessary as to the manner in which they were made.

It has been the custom of American palæontologists to record the measurements of elements in the Arthrodira without indicating clearly the manner in which they were taken. It thus happens that disagreement upon the size of a bone in a certain species may be due altogether to a difference in the mode of measurement. To obviate this source of error, a uniform method of measurement is desirable. The following is the plan adopted in the present paper and one which makes possible accurate definition. Whenever a flattened plate is under consideration, *e.g.*, an antero-ventro-lateral, its length is measured on a straight line parallel to its longest axis, a process when present being included — the length of the process is, however, also recorded separately. The width of the plate is taken at right angles to the base line, and one or more measurements are recorded according to the particular variation in form. In dealing with such a plate as the dorso-median, it is desirable to measure the width by a tape applied to the external surface between the two points farthest apart. A straight line measuring the span between the edges on the ventral side will lead to error, since all dorso-medians in any species, even when of the same age, are not equally arched from side to side, some having suffered more flattening than others. A reference to the diagrams (Fig. 1) will best bring out how the measurements in a few instances were made. The proportions of the plates preserved in the slab are given in the table on the opposite page. In two cases, indicated by an *, the restoration of contours was attempted after carefully comparing the plates in the slab with similar isolated, but well-preserved elements of the same size. Thus errors due to weathering are as far as possible eliminated.

An examination of this table shows that we have here the length of the plates forming the shoulder armor. If we supplied the length of the cranium, we would possess a complete measurement of the dorsal armor and so be enabled to calculate with some degree of accuracy the total length of the creature when alive. Fortunately data for supplying this deficiency are not lacking.

In the Newberry Collection there is another slab exposing a cranium in ventral aspect, with the antero-dorso-laterals *in situ*. This belongs to *Dinichthys intermedius* as is evidenced by the angular prominences of the posterior rims of the orbits — in *D. terrelli* these being rounded off—as well as by the proportions of the individual skull elements. The measurements of this cranium are as follows:

Length (including median-occipital process), 27 cm.
Width, at anterior margin, 20.6 cm.

MEASUREMENT OF THE BODY PLATES IN A SINGLE INDIVIDUAL OF *D. intermedius.*[1]

Name of Plate.	Length.	Width.	Remarks.
*Dorso-median	33.75 cm.	30.0 cm.	Length, excluding process, 24.4.
Antero-dorso-lateral	14.5	25.5	
*Postero-dorso-lateral	37.5	17.5	Width, omitting overlapping area, 10.0.[2]
"Premaxillary"	8.8	7.0	Length is from tip of tooth to upper inner surface; width, at process.
"Mandible"	31.0	10.0	
Sub-orbital	25.6	11.9	Length includes process; process alone 10.0.
Antero-ventro-median	14.4	7.5	Width at anterior end.
Antero-ventro-lateral			Imperfect.
Postero-ventro-lateral			Wanting.

If we now compare the antero-dorso-laterals belonging to this cranium with the ones given in the table, we may conclude from their agreement or disagreement, as to the size of the skull to accompany the measurements in the table. Unfortunately, the antero-dorso-laterals sink into the matrix at an angle, being partly hidden within and making measurement impossible. We may, however, compare the articular processes in the two, although a comparison based upon the relative sizes of processes is generally misleading as I shall endeavor to show farther on. A comparison of the processes in this specimen with those of the antero-dorso-lateral in the slab, shows that those in the former are a trifle smaller. Hence, this much is certain, that the cranium accompanying the measurements in the table is somewhat larger than 27 cm. This conclusion we are enabled to check by the study of another specimen at our disposal. There is preserved in the Newberry Collection the cranium,[3] dorso-median, and a few other plates which went together. These are in excellent preservation and allow of accurate measurement. The cranium, from the tip of the rostral to the end of the median-occipital process, is 30.6 cm. The dorso-median that accompanies it is 33 cm. long, or about 0.75 cm. shorter than the dorso-median of the slab. Hence the length of the cranium accompanying the latter must have been about 31 cm.

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[1] The measurement of various plates of this species given by Dr. Eastman are evidently of plates belonging to individuals of different ages. (*l. c.*, p. 32).

[2] Agrees with Nos. 84 and 5143 in Newberry Collection.

[3] Figured by Newberry: Palæozoic Fishes N. Amer., plate li.

We now have the lengths of the cranium and of the shoulder armor. The two together, plus an allowance of some 4 cm. for the forward projection of the "premaxillaries" as well as for the space between the cranium and the antero-dorso-laterals at the articulating processes, gives us a total length of armor in the individual in the slab, of about 70 cm. This includes the dorso-median process.

From these figures we may attempt to calculate the total length of *D. intermedius* as it must have appeared in life in the Devonian seas. That it was a creature well adapted to an aquatic life there can be little doubt.[1] This may be inferred from the vast period during which it prevailed in the waters. It had a fish-like body gradually tapering forward and backward, and somewhat flattened ventrally. These facts have been established beyond doubt by the study of a specimen[2] in which are preserved the notochord and neural arches; as well as by comparisons with the structure of the allied form *Coccosteus* as interpreted in the careful restorations of Dr. Traquair and Dr. A. Smith Woodward. *Dinichthys* very probably followed the law clearly exhibited by perfectly adapted aquatic forms: namely, the entering angle must have been in the neighborhood of 36% of the total length of the animal.[3] We therefore are justified in assuming that in *Dinichthys* the dorsal surface from the tip of the snout to a point 36% of the length gradually sloped upward; and that back of this point, to the tail, it sloped downward.

Hence the figure, 70 cm., which we obtained above as the length of the dorsal armor, will enable us to calculate the total length of the creature. We must first, however, deduct some 10 cm. for the length of the dorso-median process, which did not contribute to the upward slope, but which lay buried in muscle beneath the surface. This leaves 60 cm. as 36% of the length. Hence the entire individual whose proportions are given in the table was 167 cm. or about 5½ feet long. That this was not the maximum size attained by the species is quite certain, for Dr. Eastman mentions a dorso-median 41.91 cm. or 8 cm. longer than the one in the slab, and a cranium of *D. intermedius* in the Newberry Collection measures 33.4

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[1] H. Simroth in his 'Entstehung der Landthiere' has suggested that the primitive armored forms to which *Dinichthys* belongs were land animals. However, this view, as far as the writer is aware, has received no acceptance among morphologists.

[2] Prof. Dean's type specimen in his paper On the Vertebral Column, Fins and Ventral Armoring of Dinichthys. Trans. N. Y. Acad. Sc., Vol. XV, 1895, pp. 157–163; plate vii.

[3] *Vide*, Bashford Dean: Fishes Living and Fossil, 1895, pp. 5–7.

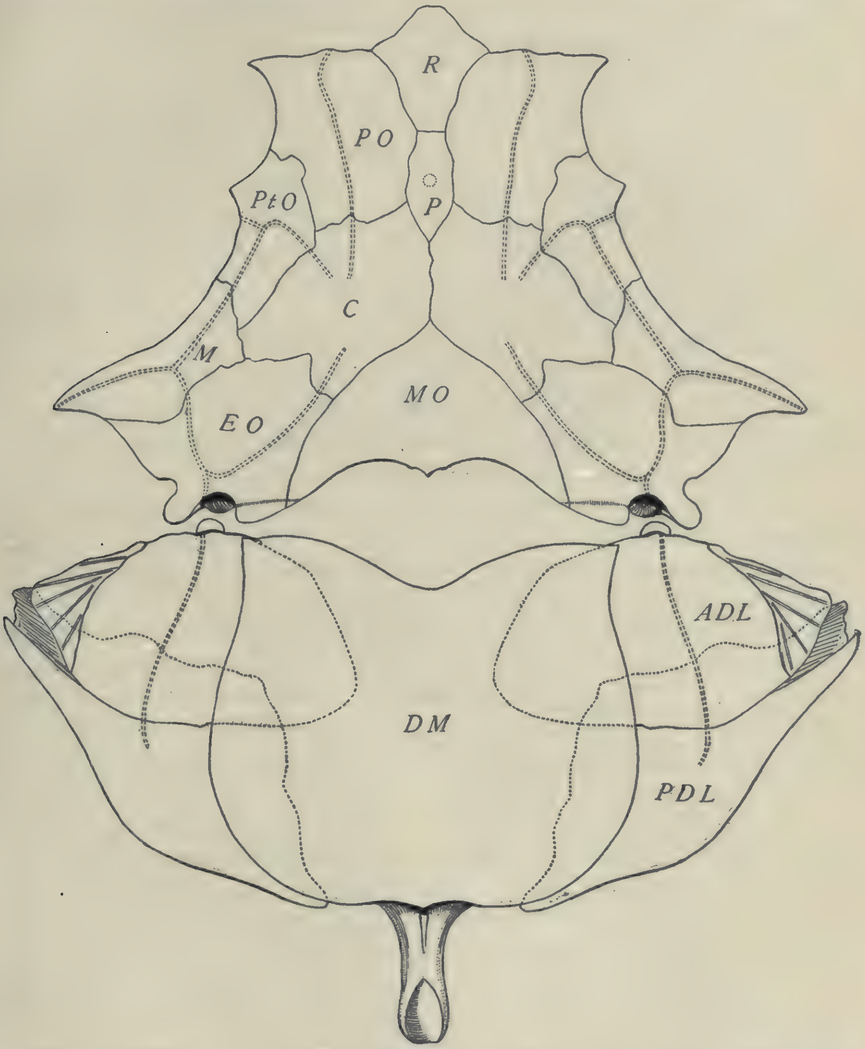

Fig. 2. *Dinichthys intermedius* Newb. Restoration of dorsal armor. × ⅛. *A D L*, antero-dorso-lateral; *C*, Central; *D M*, dorso-median; *E O*, external occipital; *M*, marginal; *M O*, median occipital; *P*, pineal; *P D L*, postero-dorso-lateral; *P O*, preorbital; *Pt O*, postorbital; *R*, rostral.

This restoration differs from the best hitherto published (Chas. R. Eastman, in Amer. Natur., Vol. XXXVII, 1898, p. 756) in a number of details, and in the following important points:

The relative sizes of the plates of the shoulder armor as compared with the cranium and amongst themselves.

The length of the Rostral and Pineal elements as compared with the length of the cranium.

The configuration of the Centrals and Marginals.

The size of the orbits.

cm. or 2.4 cm. larger than that of the individual here described. Upon a proportional estimate, the possessor of this last cranium must have been over 6½ feet in length. It may be said from the examination of certain individual plates in the collection, that *D. intermedius* probably attained a length of eight feet.

NOTE ON THE GROWTH OF DINICHTHYID PLATES.

A study of a number of well-preserved plates of the same species has enabled the writer to offer a few observations on their manner of growth. A number of juvenile specimens are preserved in the American Museum. These are in every instance thinner and smaller than the corresponding bones in older individuals of the same species, but they have attained the shape and proportions which enable us to readily identify them. Thus, there is no doubt of the identity of "premaxillaries," "clavicles," a dorso-median, etc., in the collection, in spite of their small size and delicate nature. The study of these juvenile plates as well as of bones in older individuals leads to some interesting conclusions concerning their growth.

In general we may recognize two modes of growth amongst the plates of *Dinichthys:*

1. By the periodic addition of growth zones.
2. By gradual enlargement in all directions.

I. This method of growth is especially perceptible in thin flat plates. The study of a well-preserved antero-ventro-lateral exhibits parallel to its outer edge a series of concentric lamellæ which have been added successively, resembling the growth zones in a bivalve shell. This manner of growth is clearly seen in several types of plates; for instance, besides in the example cited, in the postero-ventro-lateral and in the "maxillary"; the last, in a detached plate belonging to *D. terrelli*, presents a series of growth zones along the lower, or cutting edge. In life the "maxillary" on each side worked over the cutting edge of the corresponding mandible, by a shear-like action. This would wear down the cutting edge of the "maxillary," which therefore had constantly to be renewed. Thus the "maxillary" made good the wear and tear at the edge by the addition of new layers of dense bone.

II. The slow, uniform growth of a bone. The laws underlying this manner of growth are difficult to detect as for this purpose an extensive series of comparisons must be made in some one species, of a particular bone at different ages. Such a study of at least five stages of a dorso-median of *D. intermedius* has been made, the results of which will first be tabulated and then discussed. If authors had adopted a uniform mode of measurement a far larger series might be available for consideration.

TABLE SHOWING GROWTH OF DORSO-MEDIAN.

Specimen.	Length including process.	Length without process.	Width.	Length of process.
No. 50 *a*	26.3 cm.	20.0 cm.	24.4 cm.	6.3 cm.
50	29.9	20.9	27.2	9.0
27	33.0	24.0	28.0	9.0
slab	33.75	24.35	30.0 ±	9.4
[1] Eastman's	41.91	29.21	[26.67] [2]	12.7

This table offers several points for consideration. If we compare the proportional increase of length to width, we find a gradual but certain tendency for the bone to grow more rapidly in length than in width. Thus in the smallest specimen, No. 50*a*, the ratio of width to length is 0.93. In specimen No. 50, which is the next larger in size, this ratio is 0.91; while in specimen No. 27, the ratio has become reduced to 0.86. We are not able to present the figures for Dr. Eastman's specimen as his manner of measuring the width was evidently different from that used here; but even this limited series justifies the conclusion that the dorso-median grew more rapidly in a longitudinal (antero-posteriorly) than in a transverse (lateral) direction. What is true of the unequal growth of the dorso-median may likewise be true of other plates, but material for the further study of this point is not available.

If this conclusion be granted, an important corollary may be drawn from it, as to the classification of the species of *Dinichthys* by individual plates. Investigators have sometimes based a species on a single dorso-median; *e.g.*, *D. precursor* Newberry; *D. newberryi* Clark. That this method may be misleading is evident from the amount of difference in shape and proportions due to age and individual variation. The youthful dorso-median when placed side by side with the full-grown element of the same species, may easily be mistaken for that belonging to an entirely different type.

Another inference which follows from this table bears on the growth of the dorso-median process, which is seen to have proceeded very slowly. While the dorso-median increases in length (see third column of table) from 20.0 to 29.21 cm., a length of 9.21 cm., the process grows only from 6.3 cm. to 12.7 or 6.4 cm. In other words, the plate itself grows about 1½ times as fast as the process. The individual increments of the "peg" are very small; in one instance, for an increase in dorso-median length of 3.1 cm., there is no appreciable increase in the length of the process. Quite a minute difference in size of process, therefore, may be correlated with several centimetres of difference in the plates themselves. Consequently great care should be exercised in drawing conclusions concerning the size of plates from an examination of their processes. In our present study of the cranium of *Dinichthys intermedius*, it was seen that a minute difference in the articular processes of the antero-dorsolaterals was correlated with a difference of several centimetres in length of cranial shield.

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[1] Bull. Mus. Compar. Zoöl. Harvard, Vol. XXXI, No. 2, p. 32.

[2] Manner of measurement different from that here employed.

In conclusion, I desire to take this opportunity to thank Professor Bashford Dean for his kindness in placing in my hands the "Placoderm" material for the present paper, as well as for many helpful suggestions.

91.3,54

Article V.—ON THE ANCIENT INSCRIBED SUMERIAN (BABYLONIAN) AXE-HEAD FROM THE MORGAN COLLECTION IN THE AMERICAN MUSEUM OF NATURAL HISTORY.[1]

By George Frederick Kunz.

Plate VI.

With translation by Prof. Ira Maurice Price of the Semitic Department, University of Chicago; and the discussion by the Rev. Dr. William Hayes Ward of New York.

This remarkable stone object (a Babylonian ceremonial axe-head) was secured for this collection in 1902 in England. It is one of the oldest known stone objects of a weapon form with an inscription, although copper and metal objects were frequently so marked. It is historic and almost unique.

This axe was obtained by the Cardinal Stefano Borgia while at the head of the Propaganda, but whence or how is not known. (See note at the end.) The Contessa Ettore Borgia, his niece, offered it to the British Museum some ten or twelve years ago, but at so extravagant a value (about three or four thousand pounds sterling) that it was returned to her. It was ultimately acquired for some 15,000 lire by the late Comte Michel Tyszkiewicz,[2] and soon after his death there was a dispersal of his collection of engraved stones, bronzes, marbles, and other antiquities. After the sale, the axe was purchased for Messrs. Tiffany and Co. by the author, and, through the generosity of James Pierpont Morgan, Esq., was presented to the American Museum of Natural History, New York City, on April 16, 1902.

The object measures in length 134.5 mm., width 35.5 mm., thickness 31 mm., and weighs 226.8 grammes.

It is made of banded agate, the layers being very parallel, so much so that it might well be called an onyx. The color is a snuff-brown, really a deer-brown. It is in part spotted and splashed with white, evidently due to contact either with fire, or fire and some alkali, such as soda. This *patina* covers the larger part of the inscription, and has been produced since the latter was cut. The incising was the result of bow-drill work. The hardness is 7. On the reverse is a letter W, very rudely picked in with a steel tool. But this is evidently of very recent date.

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[1] Read before the New York Academy of Sciences, Jan. 29, and Feb. 27, 1905.

[2] Collection d'Antiquités du Comte Michel Tyszkiewicz, decente par W. Froehner. Paris, 1898. Folio, p. 97, plate xxxii.

This axe-head was first described by Francesco Lenormant, in 'Tre Monumenti Caldei ed Assiri di Collezioni Romane' (Rome, 1879, pp. 19, with plate vi, fig. 1, pages 7–9).

Inscribed stone axes are rare and of great interest; those of metal are less unusual. The votive axe of Thothmes III was so inscribed. (See p. 60, Illustration I, 'The Dawn of Civilization, Egypt and Chaldea,' by G. Maspero, New York, 1894; 8vo, pp. 800.)

The deciphering of this inscription could be done by but few Babylonian scholars in the United States. Prof. Ira Maurice Price, of the Semitic Department of the University of Chicago, very kindly undertook the task. His letter is as follows:

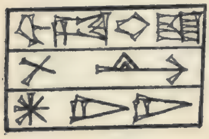

Fig. 1. Inscription, actual size (1 in. x $\frac{5}{8}$ in.).

"The little inscription that forms the subject of this note is an intaglio on the side of an axe-head made of banded agate, as seen in the accompanying illustration (Fig. 1). It occupies the space of one inch in length by five-eighths of an inch in width. It consists of three lines written in archaic Babylonian characters, of which the accompanying cut is a facsimile reproduction.

"The character of the signs is that current in Babylonia from the earliest times down to 2000 B.C., both on cylinder seals and in larger inscriptions. The language is the primitive form of the cuneiform languages called "Sumerian" by one school, and by another "Akkadian." Its out-standing feature is that it is written largely in ideographs, signs that designate ideas, rather than syllables. This was the favorite method of marking important documents, or dedicating them to some particular divinity or divinities.

"The accompanying cut (Fig. 2.) is a transliteration of the inscription into the later Assyrian character, the form of writing current in Assyria from 1500 to 606 B.C.

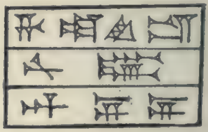

Fig. 2. Assyrian character.

"The transliteration[1] of the ancient Babylonian is as follows:—

HA AD-DUG-ISH
PAP SHESH
dingir U ZAL-NI

"The Assyrian equivalent of the text may be indicated in the following form:—

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[1] Lenormant, F., in 'Tre Monumenti Caldei ed Assiri,' Roma, 1879, pl. xiv, gives a transliteration into Assyrian of this inscription, but he misread the first two signs in the first line, and the first two in the third line. He finds the god Ramman, however, and gives an appropriate description of him.

duppi Ad-dug-ish
asharidu
ilu Shamash baru-shù

"The translation of the text as just transliterated is:—

The inscription of Ad-dug-ish
the governor
(dedicated) to the god Shamash, his benefactor.

"This small inscription, like most of those written in the so-called Sumerian language, is capable of more than one rendering. The one presented above is based in part on a fragment of a syllabary found in 'Cuneiform Texts of the British Museum,' Vol. XII, plate 31, No. 38182. There we find H̠A =*nu-u-nu* (='fish'); *du-up-u* (='tablet' or 'inscription'); *pu-ra-du*, whose meaning is uncertain. It is also possible to read the first line in the inscription as the proper name, thus: 'Haddugish, the governor, (dedicated) to the god Shamash, his benefactor.'

"Another possible rendering is to take the first sign in the first line as naming a particular stone, the determinative sign usually found before such words in prose being omitted. This omission, especially before signs whose character can be otherwise determined, is frequent in the so-called Sumerian inscriptions. The syllabaries (Brünnow, No. 11822) designate a fish-stone (=*aban nûni*), which has been thought by some scholars to be *os sepiæ*, (='cuttle-fish bone'). May it not be that this first sign in the first line designates a stone, which, because of its banded character, is likened to a fish? Hence it could be read 'the precious stone of Ad-dug-ish,' etc.

"In some of the combinations of signs, where the first sign in the first line is an element (*cf.* Brünnow, Nos. 11843, 11845) we find such a meaning as 'defense,' 'protection.' It is not impossible that such a meaning may be attached to this axe-head, used as a symbol of defense against an enemy. If such a sense were possible, then the last line might be read 'To the god Adad, his lord.' The entire inscription would then read 'The defense of Addugish, the governor, (dedicated) to the god Adad, his lord.'

"It seems evident from the usual custom in the use of such inscriptions that the first sign should designate something relative to the object on which it is found. Hence the designation 'stone,' or ('precious) stone,' indicated in the suggestion made above, may be the true meaning for this bit of an inscription. The last line contains first the designation of a divinity, probably either Shamash, or Adad, the archaic small circle being used for the usual sign *U* in later

Assyrian. Shamash seems to be appropriate, for he was the sun-god, whose warm light fed the life of man, beast, and vegetable, and made the earth bring forth in abundance to feed man and beast. The signs translated 'his benefactor' might be more fully rendered by a paraphrase, 'the one who supplies him with abundance.' On the other hand, Adad was the weather-god, the thunderer, who poured out the floods, and who appeared as a warrior with a weapon in one hand and a thunderbolt in the other. On seals he often leads a bull by a leash. If the god in the last line of this inscription should be read 'Adad,' then there may be some reason in translating the first sign as 'defense,' 'weapon,' making the axe-head supply a symbol of the principal attribute — the war-like one — assigned to the god Adad. The last two signs may then be read as 'his lord,' 'his conquering one,' etc.

"An alternative reading for the inscription would then be:—

The (axe-head) stone of Ad-dug-ish
the governor,
(dedicated) to the god Adad, his lord.

" 'The governor' was a 'leader' or a 'prince' of the first rank, in authority. In fact, it is an epithet which some of the divinities assign to themselves as indicative of their rank. Therefore this axe-head was the possession of an official of high authority,— and of one who was devoted to his god as his benefactor, or his conquering lord."

In regard to the use of the axe in early Babylonia, Dr. W. Hayes Ward says:

"Axes or celts, whether of stone or copper, are extremely rare from the region of primitive Babylonia, although celts are not infrequent in Asia Minor. The axe was, however, perfectly well known from the earliest times in Babylonia, and is figured both on the cylinders and on bas-reliefs. On a cylinder in the Berlin Museum, V. A. 243, the three weapons more usual on the cylinders are drawn, in the field, side by side, between the two standing figures, thus (Fig. 3):

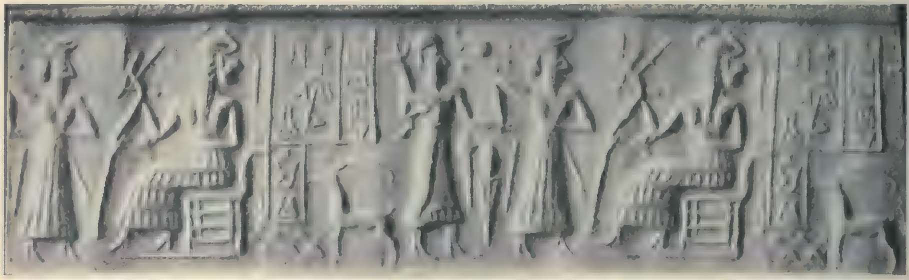

Fig. 3.

" This is the usual appearance of the axe on the cylinders, but it is not a frequent weapon, the poniard, and especially the club, being more frequent. In De Clercq's 'Catalogue methodique et Raisonné,' pl. 21, Ramman is figured with a weapon thus (Fig. 4):

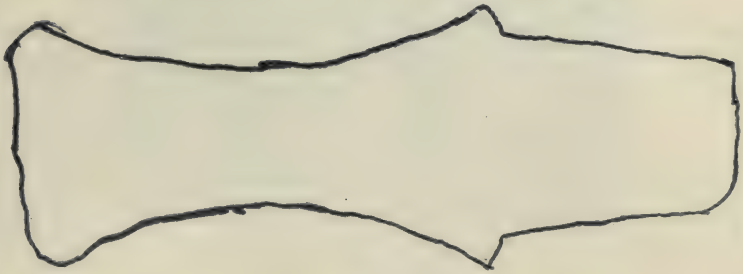

Fig. 4.

" In the archaic 'Stele of Vultures' of about 4000 B.C., or earlier, is a figure of a king seated in his chariot, carrying a quiver with arrows, and what may be a peculiar bow, but looks more like a boomerang. Following him are his soldiers armed with spears and battle-axes shaped (Fig. 5): (See De Sarzec, 'Découvertes en Chaldée,' pl. 3 bis. See also pl. 5 bis, 3 b, for similar axes). But that the double axe was known is shown by a terra-cotta votive axe, *ib.*, pl. 45, 5.

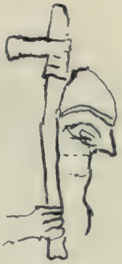

Fig. 5.

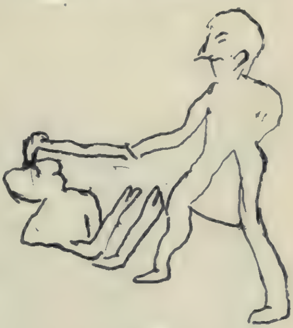

Fig. 6.

"In the bas-relief of Naram-Sin, King of Agade, in Babylonia, generally supposed to have reigned about 3750 B.C., the king is armed and followed by his soldiers, who are armed, in part, with axes. For the shape of the axes see De Morgan, 'Délégation en Perse,' I, p. 150.

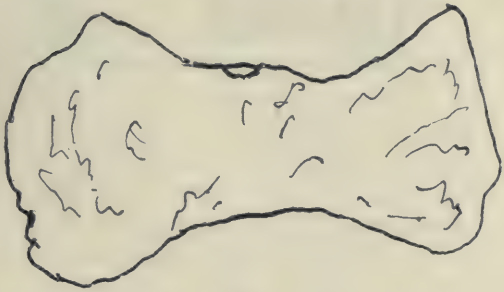

Fig. 7.

"Babylonian axes are not to be found, I think, in the art after perhaps 3000 B.C., until we come down to the axes of the northern region, which came in with the two-edged *bipennis* axe carried by Adad, or the chief god of the Hittite region. There it was a frequent object, and is found in Cretan art.

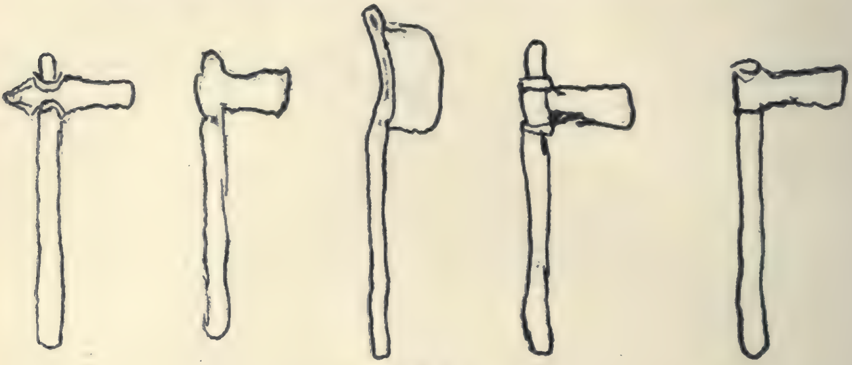

Fig. 8.

"Among the cylinders showing the axe is that of the goddess attacked under a tent-tree (Fig. 9). (See Sarzec, 'Découvertes en Chaldée,' pl. 30 bis, 17 b.) Here the shape of the axe wielded by the god who hacks at the tree is (Fig. 9):

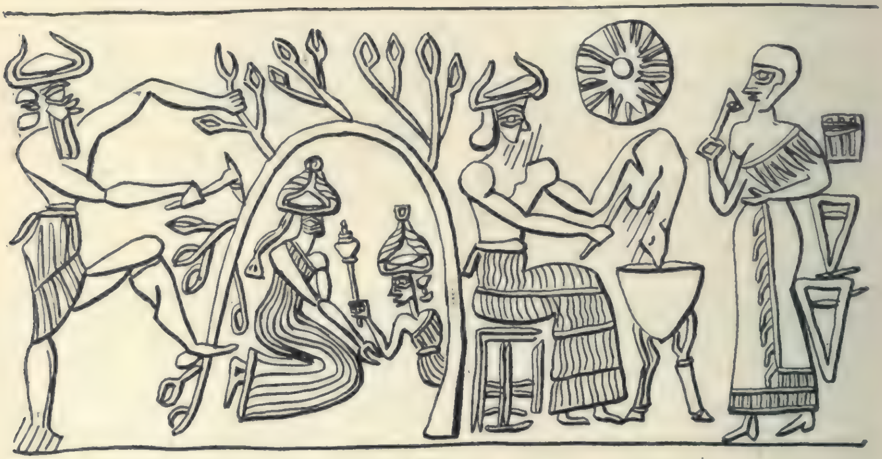

Fig. 9.

"In the case of the 'British Museum Cylinder Migration Scene,' two of the men carry an axe on their arm shaped (Fig. 10):

"In the Bibliothèque Nationale, Paris, is a cylinder drawn with an axe in the field, between the two central standing figures, thus (Fig. 11)."

Lenormant is uncertain as to the translation of the first two lines of the inscription; the third he renders 'To his god,' probably Ramman, the Rimmon of the Bible (2 Kings v, 18), the god of thunder, lightning, and all atmospheric phenomena. He figures the inscription, on page 7, enlarged, and transliterated into the later cuneiform, as in Prof. Price's second figure; but regards the language as a very archaic Sumerian or Accadian form, of agglutinated character and almost impossible to render with any certainty, in the absence of some bilingual inscriptions as a guide. He points out that the object was strictly votive, or religious, in its nature,—a symbol and not a weapon,— and was connected with the widespread early veneration for celts and stone hammers, as supposed to have fallen from the gods; whence for votive purposes a stone object was made in preference to a metal one.

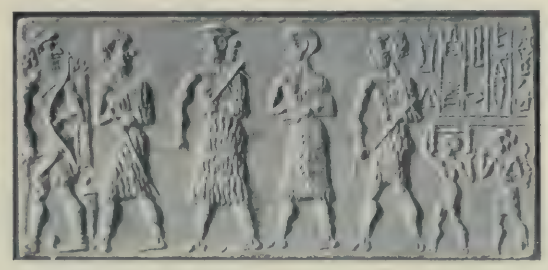

Fig. 10.

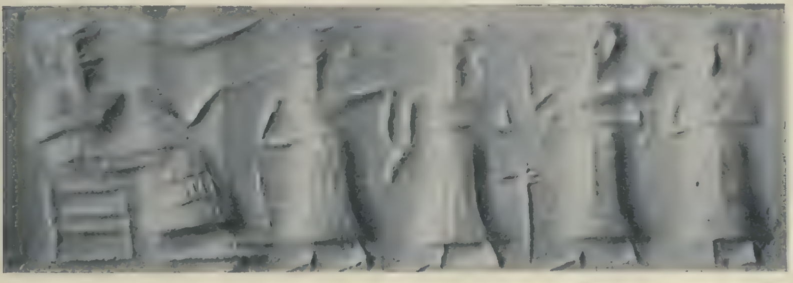

Fig. 11.

He cites an Assyrian bas-relief (from Layard), in which the statue of Ramman is carried in procession. He has four horns on his head, at his feet are the thunderbolts, and he carries a hammer in his hand. This hammer in the hands of Ramman had among the Babylonian Chaldeans the same significance as the hammer of Thor in the

Scandinavian mythology. The general credence was that the bolts from the god fell on earth in the shape of hammers of stone. Therefore, the dedication to the god found a greater significance in the shape of a stone hammer or battle-axe than in one of metal. ('Tre Monumenti Caldei ed Assiri': pp. 8, 9.)

The literature teems with curious and interesting accounts of the varied and widespread superstitions relating to prehistoric stone implements of all kinds, throughout Europe and Asia. Celts and stone hammers were believed almost everywhere to have fallen from the sky in connection with thunderstorms; and arrow-heads were called 'fairy darts' and 'elf darts'; and all were supposed to have potent influences as charms. E. F. Stevens relates many singular superstitions about elf-darts in Ireland, Scotland, and Scandinavia, and even as far as Japan, where flint and obsidian arrow-heads are thought to be used by spirits. These were believed to fly through the air in storms, and to drop their weapons on the earth; and the people go out afterwards and look for them on the ground. In Ireland and Scotland they were worn upon the person as charms; and they are sometimes found in ancient Greek or Etruscan jewelry, as pendants. The belief that stone axes were connected with thunder was widespread; they were known among the Greeks as *astropelekia*, *i. e.*, star-hatchets, and *keraunia*, thunder-stones. In Europe in the Middle Ages, they were supposed to be always discoverable at the roots of a tree that had been struck by lightning, or beneath a house so struck, and were credited with all manner of virtues,—to protect a house from lightning, to cure diseases in men and animals, to give strength and victory in contests, etc. Such an axe was hung round the neck of the ram or goat that led a flock, to preserve the whole of them from accident or the 'evil eye.' The Scandinavian folk-lore and Sagas tell of 'victory-stones' 'Thor-stones,' worn by chieftains, which rendered

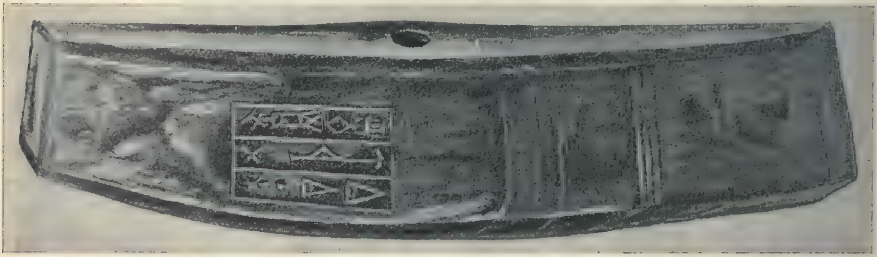

Fig. 12. Chaldean Hammer bearing an inscription.

them secure and successful in combat. Two such narratives may be cited, from the Bern's Saga, one of King Nidung, and the other of Sigurd, who were made victorious by such stones, which were undoubtedly amulets of this kind. ('Flint Chips,' pp. 873–890.) Galba, when general, found twelve celts in a small lake which he drained when that was struck by lightning, and believed he was to be a great man. The modern archæologist knows that it meant that Galba had found the site of an ancient Lake Dwelling.

Maspero refers to this very specimen, in speaking of ancient axes. He says: (The Dawn of Civilization, p. 755):—

"A few examples, it is true, are of fairly artistic shape, and bear engraved inscriptions: one of these, a flint hammer of beautiful form, belonged to a god, probably Ramman, and seems to have come from a temple in which one of its owners had deposited it. It is an exception, and a remarkable exception. Stone was the material of the implements of the poor—implements which were coarse in shape and cost little; if much care were given to their execution, they would come to be so costly that no one would buy them, or, if sold for a moderate sum, the seller would obtain no profit from the transaction. Beyond a certain price, it was more advantageous to purchase metal implements

"It was found in the ancient collection of Cardinal Borgia, and belonged some years ago to Count Ettore Borgia. An engraving of it was given in Stevens, 'Flint Chips,' p. 115, and a facsimile of it by Fr. Lenormant, 'Tre Monumenti Caldei,' etc., 1879, pp. 4–9, and pl. vi., 1; Cartailhac, 'L'Age de la Pierre en Asie,' in the Troisième Congrés provincial des Orientalistes, tenu à Lyon, Vol. I., pp. 321, 322, has reproduced Lenormant's notes on it.

"Drawn by Faucher-Gudin, from the illustration published by Fr. Lenormant, 'Tre Monumenti Caldei,' etc., pl. vi., No. 1." (*Ibid.*, foot-note.)

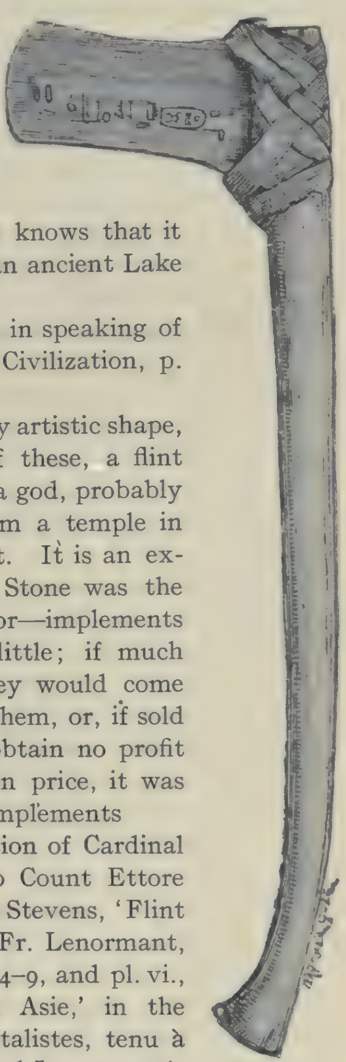

Fig. 13.
Votive Axe of Thothmes III.

He also says of ancient axes in general (*ibid.*, p. 60, foot-note):—

"Finally, the crook and the wooden-handled mace, with its head of white stone, the favorite weapon of princes, continued to the last the most revered insignia of royalty.

"The blade is of bronze, and is attached to the wooden handle by interlacing thongs of leather (Ghizeh Museum). Drawn by Faucher-Gudin, from a photograph by Emil Brugsch-Bey.

"The crook is the sceptre of a prince, a Pharaoh, or a god: the white mace has still the value apparently of a weapon in the hands of the king who brandishes it over a group of prisoners, or over an ox which he is sacrificing to a divinity (Lepsius, Denkm., II., 2 a, c, 39 f, 116, etc.). Most museums possess specimens of the stone heads of one of these maces, but the mode of using it was not known. I had several placed in the Boulak Museum (Extrait de l'inventaire, p. 10, Nos. 26586, 26587, in the 'Bulletin de l'Institut Égyptien,' 2d series, Vol. VI). It already possessed a model of one entirely of wood (Mariette, 'La Galerie de l'Égypte ancienne,' p. 104; Maspero, 'Guide,' p. 303, No. 4722)."

It is certainly a matter for congratulation that this remarkable and almost unique specimen should have been secured for this Museum.

Note.—Stefano Borgia, Italian ecclesiastic (born Velletri, Dec., 1731, died Lyon, 23d Nov., 1804), was brought up by his uncle Alessandro Borgia, Archbishop of Ferno, and in 1750 on becoming a member of the Etruscan Academy of Cortona, commenced at Valletre to form one of the richest collections (private) in the world. In 1759 he was appointed by Benedict XIV governor of Benevento, and in 1770 he became secretary to the College of the Propaganda, which brought him into immediate relations with missionaries to all parts of the world, and enabled him, at comparatively little expense, to enrich his museum with manuscripts, coins, statues, idols, and all other rarities which each country possessed. In 1789 Pius VI made him a Cardinal, and at the same time appointed him inspector general of the foundling hospital, into which he introduced extensive reforms. In 1797 the revolution spirit, which had broken out in France, extended itself to Rome, and the Pope, as the best means of counteracting it, gave all his confidence to Borgia and installed him as director. He was arrested, and after his release was ordered to quit the Papal States. After embarking at Lisbon he went to Venice and Padua; returning to Rome, the new Pope Pius VII treated him with the same respect and confidence. He died while accompanying Pope Pius VII to France. He was author of several antiquarian and historical works, and deserves honorable mention for his liberal patronage of art and artists. Count Ettore Borgia, a nephew, inherited a part of his collections. But the main portion in archæology is now in the Royal Museum of Antiquities at Naples; the lesser part, containing the books, manuscripts, letters, etc., is in the College of the Propaganda at Rome.[1]

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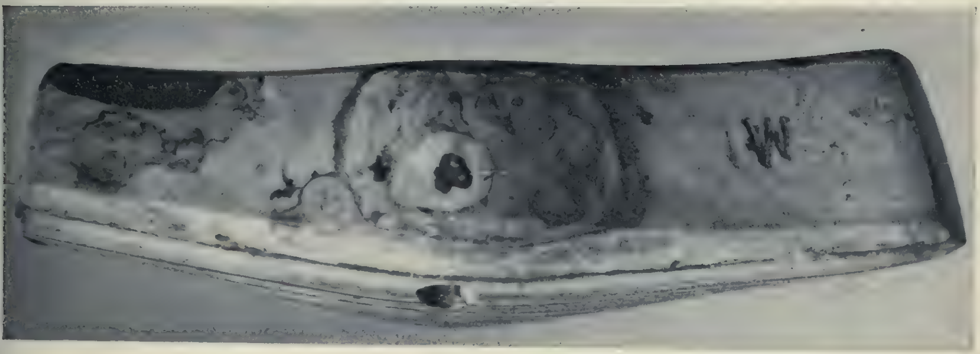
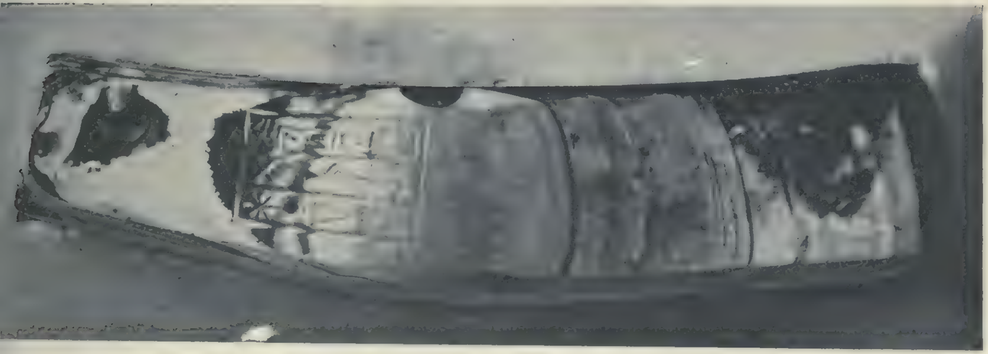
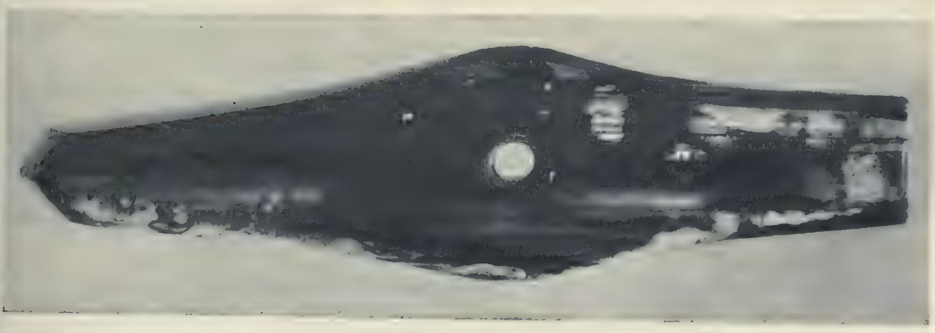
[1] Thanks are due to the Rev William Hood Stewart of the Roman Catholic Church of the Epiphany, New York City, for much of the information in regard to Cardinal Stephano Borgia.



1. Obverse.



2. Reverse.



3. Edge.

Ancient Babylonian Axe-Head.

91.3,54

Article VI.—AN ANCIENT BABYLONIAN AXE-HEAD

By Prof. J. Dyneley Prince and Dr. Robert Lau.

Plate VI.

In the Tiffany Collection of gems belonging to the American Museum of Natural History is a remarkably perfect and very ancient Babylonian axe-head of pure agate. This object was originally obtained by Cardinal Borgia while at the head of the Propaganda and was subsequently offered by the Countess Ettore Borgia to the British Museum for sale, whence it was returned to her, owing to the Museum's lack of funds to purchase it at that time. It was then acquired by Count Michel Tyszkiewicz for the sum of 15,000 lire (Italian), who kept it until his death, when it was purchased by Mr. George Kunz, of Tiffany & Co., of New York, by whom it was added to the Tiffany Collection, which was later presented to the American Museum of Natural History by Mr. J. Pierpont Morgan.

The axe-head is interesting, not only because of its extreme beauty as an artistic production, which undoubtedly entitles it to its very prominent position in this unique collection of gems and rare coins, but also because of the inscription in archaic Babylonian characters, with which its obverse side is embellished. A discussion as to the probable age of this object must depend, first, on the nature of this inscription, and, secondly, on the character of the agate of which the hammer is made.

The dimensions of the Morgan axe-head are as follows: Length, 13.7 cm.; width over the handle-perforation, 3 cm.; length of the back, 1.7 cm.; width of the back, 1.9 cm.; diameter of the perforation, 0.9 cm.

There can be no doubt that the axe-head was a votive object presented to some temple in Babylonia. It is unfortunate that the place where it was originally excavated is not known, as in that case much might be learned regarding the date of the object, which now depends entirely on deduction. This is *not* unique as a votive axe. A fragment of a similar axe in imitation of lapis lazuli, 6.75 x 4.25 x 1.5, was found at Nippur, in Southern Babylonia, by the recent American Expedition to that site. This Nippur axe shows an inscription of seven lines, which may be transliterated and translated as follows:

1.	. . . . . *-ni-šu*	‘his . . . . .
2.	(*Na-zi*)*-ma-ru-ut-taš*	Nazimaruttash
3.	. . . . . *nu* . . .	
4.	. . . . . . *-šu*	his . . . . .
5.	(*apal Ku-*)*ri-gal-zu*	the son of Kurigalzu
6.	(*iq-ri*)*-bi-šu a-na še-me-e*	for hearing his prayers
7.	(*ûmi-i*) *šu-ur-ru-ki*	(and) lengthening his days (has given).’

For the Babylonian text alone, see Hilprecht, ‘The Babylonian Expedition of the University of Pennsylvania,’ I, part ii, plate 61, nr. 136. The king Nazimaruttash (*ca.* 1340 B.C.), the son of Kurigalzu II (*ca.* 1350 B.C.), was evidently the donor of this Nippur axe-head to the temple of some god whose name is mutilated. The inscription shows how the gift of the object was thought to induce the god to look favorably on the donor, whose gift should be an incentive to the god “for hearing his prayers and prolonging his days.” The Nippur axe was found at Nippur in a chamber on the edge of the canal outside of the great southeast wall. It is evident, therefore, that, although this Nippur axe-head is far inferior, from the point of view of pure art, to the Morgan axe-head, the former object is more valuable from an archæological point of view, as we have the exact data regarding it and are able to determine its age with absolute accuracy. It is clear, however, that we must expect an inscription of similar import on the Morgan axe-head, which was plainly an object intended to serve the same votive purpose as that of the Nippur axe.

The text on the Morgan axe-head consists of three lines, very carefully carved inside of a regular cartouche, as follows:

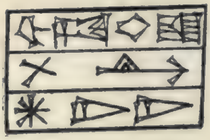
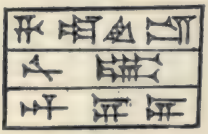


Fig. 1. Inscription, actual size (1 in. x ⅝ in.)

This may be transliterated into the later cuneiform text as follows:



This may be transliterated in Roman character and translated as follows:

1.	*Xa-aṭ-ṭi-iš*	'Khattish,
2.	*âšârid*	the chief person (favorite)
3.	*ilâni*	of the gods (presented it).'

That the first line shows a proper name is evident, although we miss here the customary upright determinative, usually preceding proper names. This omission, however, is not without parallel(cf. *op. cit.* plate 51, nr. 121, line 4, the king's name *Ur-(ilu)Bau; op. cit.* plate 36, nr. 86, line 2, the king's name *Lugalkigubnidúdú*, etc.). There is no exact parallel to the name *Khattish*, which is probably not a royal name, but that of a high official at some Babylonian city, court, or perhaps that of a local governor, as the axe-head seems to antedate the unification of Babylonia under the hegemony of the city of Babylon by Hammurabi (2342–2288 B.C.). It should be noted, however, that the name *Xa-aš-xa-mi-ir* occurs I. Rawl. 1. i. nr. 10, as that of a ruler (*patesi*) of the city of *Iš*(?)*-ku-un-Sin*. This name, *Xašxamîr*, seems to be a name of the same general character as *Xa-aṭ-ṭi-iš* (see for *Xašxamir*, Radau, 'Early Babylonian History,' p. 30, note). The two signs which are translated *ašârid*, 'chief person,' occur in this sense, V. Rawl. 44, 36c, referring to the god *Ninib* as the *ašâridu*, the usual ideogram for which, however, is SAG-KAL and *not* our combination PAP-ŠEŠ, which is very rare. The last line presents no difficulty, as the three signs, AN-NI-NI, can only be the ideogram for *ilâni*, 'gods.' It is clear that the verb *iqîš*, 'he presented (it),' must be understood as the grammatical complement to the inscription, which is complete and shows no traces of mutilation.

The characters of this inscription are very antique, approaching more closely in form those of the Gudea period (*ca.* 3000 B.C.) than those of later date. On the other hand, the dated inscriptions from the time of Gudea show a slightly more linear and less cuneiform character than do the signs on the Morgan axe, where the wedge is beginning to appear, which leads us to the opinion that this inscription may date between Gudea's time and that of Hammurabi (2342–2288 B.C.), when the wedge was even more prominent than we see it in the inscription on the axe-head. The objection may always be raised that we have here a piece of much later work, with the inscription deliberately written in archaic characters after the style of some of the documents of Nebuchadnezzar II (604–562 B.C.), who caused inscriptions to be written in imitation of the earlier

Babylonian writing. This does not seem probable to us, owing to the general character of the signs in question, which are too naturally cut to admit of this supposition. Deliberate archaization would, we think, have produced a somewhat more clearly cut inscription and also one in which the linear tendency was not so well marked as we have it here. The accompanying photograph illustrates the linear character of these signs better than the written reproduction.

The stone is distinctly agate in layers, not agate with circular or ring-like marking, which would militate against a very ancient date for the object. The appearance of the *layers*, however, does not preclude the date which we suppose for the Morgan axe, *i. e.*, between 3000 and 2300 B.C., probably nearer 3000 B.C. than the later date.

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Article VII. —A CONTRIBUTION TO THE LIFE HISTORY OF THE AMERICAN FLAMINGO (*PHŒNICOPTERUS RUBER*), WITH REMARKS UPON SPECIMENS.

By Frank M. Chapman.

Introductory.

It is a well-known fact that the Flamingo is a locally abundant bird in the Bahamas and that it breeds in certain islands of this group. Few writers on Bahaman birds, from Catesby to the present day, fail to mention this bird, but, so far as I am aware, there exist in scientific literature but two descriptions of an occupied nesting ground of Flamingos in the Bahamas; the first, by C. J. Maynard, the second by Sir Henry Blake.

On May 14, 1884, Mr. Maynard visited a rookery estimated to contain "in the neighborhood of 2000 nests, and," he states, "in all of these we found only some fifty sets of two eggs, and three in one case only." Mr. Maynard adds that when he got within about two hundred yards of the rookery the birds began to "pour out." Several were shot as they left the rookery and a few more were secured as, from time to time during the day, the birds "singly" and in "small groups" returned to reconnoitre, but the rookery was not reoccupied during the day of Mr. Maynard's stay.

Mr. Maynard gives a detailed description of the Flamingos' nests, and states that "as we came up to the rookery we had seen hundreds of birds sitting on their nests with their legs doubled under them, not hanging down as is usually represented." Mr. Maynard published the results of his observations in 'The Florida Naturalist' (1884, No. 1) and in his 'Birds of Eastern North America' (1896, pp. 103–113). He was, I believe, preceded in his discovery of the correct attitude of the Flamingo when sitting upon the nest only by H. H. Johnston (Ibis, 1881, p. 174) and Abel Chapman (Ibis, 1883, p. 397; 1884, pp. 88, 89, pl. iv), who had made similar observations in regard to the European Flamingo (*Phœnicopterus roseus*).

Sir Henry Blake, while governor of the Bahamas, visited an occupied Flamingo nesting ground June 7, 1886, when the incubating birds were watched with glasses at a distance of one hundred and fifty yards and seen to have their legs folded under them in the "usual manner" (Nineteenth Century, 1887, pp. 886–890; see also Ibis, 1888, p. 151).

To the accounts of the authors above mentioned I am privileged to add the results of observations made by myself, in May, 1902, and in May and June, 1904.[1]

It was my especial good fortune, on the first-named occasion, to join forces with Mr. J. Lewis Bonhote of Cambridge, England. As secretary to the Governor of the Bahamas Mr. Bonhote had exceptional opportunities to secure information concerning the localities in which Flamingos were known to nest. With a guide supplied by the Rev. Mr. Matthews, of whom mention is made below, he had previously reconnoitred the ground, and under his leadership no difficulty was experienced in reaching a region in which were several colonies of nests occupied by Flamingos in previous years. We did not, however, succeed in finding the birds breeding. Accounts of this expedition were published both by Mr. Bonhote and myself.[2]

Circumstances preventing a return to the Bahamas in 1903 to continue the search for the Flamingos' nesting ground, through the kind coöperation of the Rev. C. E. Meeres, of Nassau, a negro member of our 1902 expedition was dispatched to the region then visited, with instructions to ascertain whether the birds returned to breed there. He failed to find them.

Later in the year, Mr. Meeres placed me in correspondence with the Rev. F. Barrows Matthews who, residing on the island in which the Flamingos nest, was most favorably situated to aid the Museum in its explorations. Mr. Matthews's coöperation proved invaluable.

Much to my surprise I found that the abandoned nesting ground visited by Mr. Bonhote and myself in 1902, had been discovered by Mr. Matthews, on May 28, 1898. At this time it was occupied, eggs were hatching, and young old enough to run about were seen. Mr. Matthews published an account of his observations under the heading 'Expeditions,' in the Nassau Mission Quarterly, for September, 1898. To the best of my knowledge this is the first published description of a Flamingo rookery containing young birds.

At the approach of the 1904 breeding season, Mr. Matthews, acting as the Museum's representative, sent negroes to search for the Flamingos' nesting grounds. After several weeks' hunting, during which time a large area was covered, a colony of laying birds was found May 8, 1904.

In the meantime, accompanied by Prof. W. M. Wheeler, I had

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[1] See also The Century Magazine for December, 1904, in which a popular account of the Museum expedition was published, and Bird-Lore for December, 1904, where a short account of the habits of the young was given.

[2] See Bonhote, Avicultural Magazine, 1903, p. 8, and Ibis, 1903, p. 310; Chapman, Am. Mus. Jour., 1902, p. 78, and Bird-Lore, 1902, p. 177.

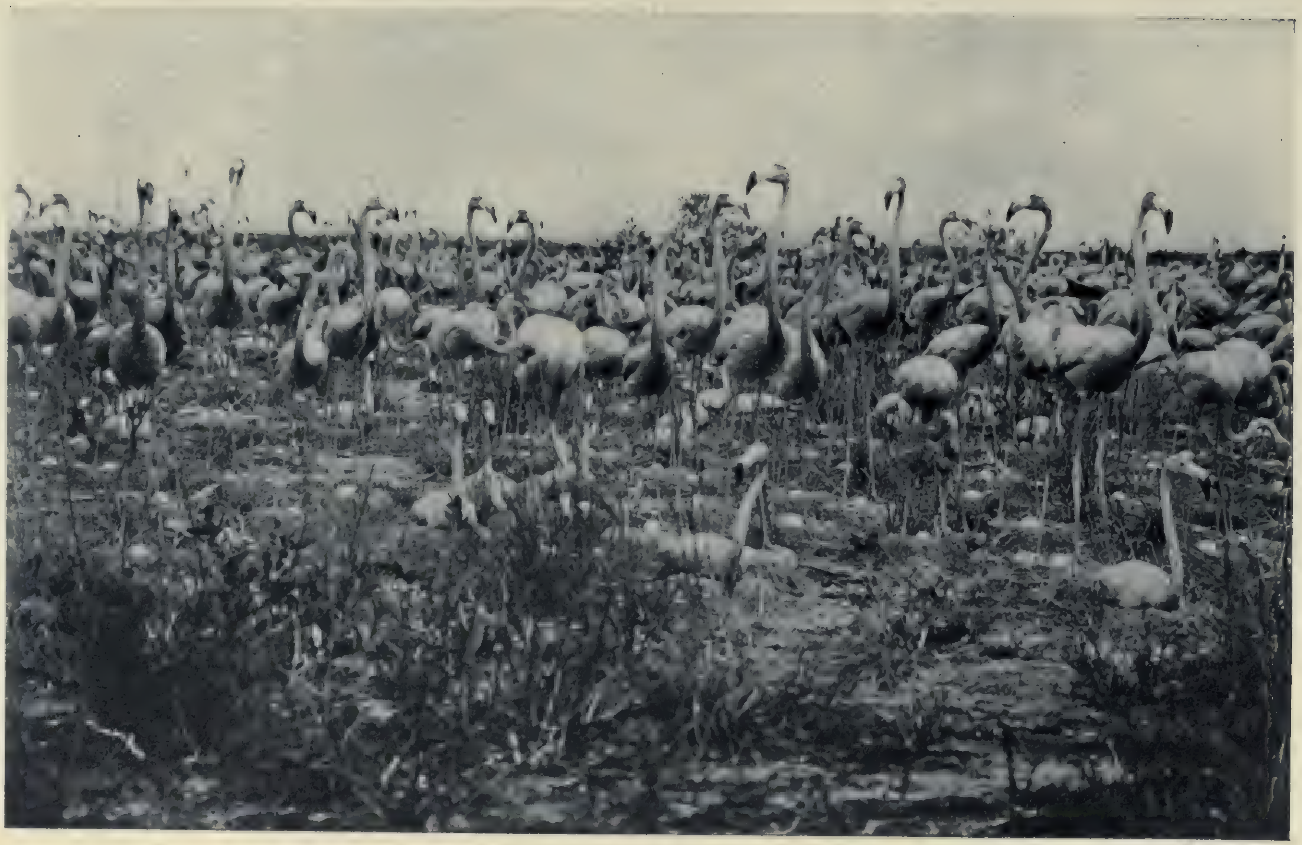

Fig. 1. The Colony Alarmed.

sailed from Miami, Florida, in the schooner yacht 'Gloria' which had been placed at the Museum's disposal by Mr. N. D. Bill of Springfield, Mass. Owing to head winds and mishaps of various kinds Mr. Matthews's home was not reached until May 17. Here we shipped as guide the negro 'Peter' who had found the birds, and continued our voyage, reaching the Flamingo rookery May 20.

The rookery, however, proved to have been flooded by the severe rain storm of May 17, when six inches of rain fell within three hours. Many of the nests were still submerged, fresh eggs were floating in the water or were stranded in the mud. About twenty Flamingos were seen during the day, but the colony, which had evidently contained several hundred birds, had disappeared.

Later we learned that subsequent to the storm the rookery had been visited by negroes who had gathered large numbers of eggs for food.

No other nesting place was discovered, and on May 28 we sailed for Nassau to replenish our supplies and meet additions to our party. In the meantime Peter was sent to the locality visited in 1902. On our return, June 4, he reported that the Flamingos were nesting there in large numbers and that already eggs were hatching. We at once set sail for the place, reaching it June 7. Our tent was pitched about one mile from the rookery which, at that distance, appeared across the 'swash' as a thin pink line. Under favorable conditions of wind the voice of both adult and young birds could be plainly heard from our camp.

We remained here until June 14, during which time the Flamingos were under constant observation. For birds usually so shy they proved unexpectedly tame near their nests. They deserted the rookery, it is true, when one was distant about one hundred and fifty yards, but settled in a bordering lagoon and returned to their nests as soon as one was a few hundred yards away.

A cloth blind erected over an umbrella, and screened by branches, was placed behind a bush thirty feet from the border of the rookery, and, later, in a bush near the center of the rookery, without apparently arousing the birds' suspicions. From the first-named position an opportunity was afforded to observe the colony as a whole; from the second, the individual was studied from as near as six feet. The results of these studies are appended.

REMARKS ON HABITS.

Time of nesting. — While there is evidently some variation in the time when the Flamingos of the western Bahamas begin to nest it is probable that ordinarily they begin to lay the first week in May. Mr. Matthews tells me that he has seen newly hatched birds as early as May 28. The nests found the present year on May 8 contained fresh eggs; and in the rookery where my studies were made newly hatched young birds were seen by Peter on June 1. On my first visit to the rookery, June 7, I saw but two young, both less than two days old, but when I left the rookery there were hundreds of young birds running about. There were still large numbers of eggs containing half-grown embryos, and the fact that they were in low nests, which appeared to have been hastily constructed and were grouped together at the border of the rookery farthest from the water, induces the belief that possibly they were occupied by the birds which had been washed out on May 17.

I at one time believed that the date of the Flamingos' breeding season was dependent upon that of the beginning of the rainy season when, obviously, the available breeding area would be greatly increased. Since, however, the rainy season is not inaugurated before May 15, and the birds must evidently begin to build late in April, there can be no close connection between the dates of these events.

The nesting ground. — The nesting ground selected by this colony of Flamingos was an extension of that occupied by probably the same colony of birds in 1901 (see Bird-Lore, 1902, p. 179). In that year the nests were placed among large red mangrove bushes where but few could be seen at one time. The area occupied in 1904 is more open in character, the only conspicuous vegetation being coarse grasses, buttonwood shoots, and one good-sized buttonwood bush.

It is evident that in selecting a nesting site the birds are governed not by the nature of the vegetation, but by the height of the water. Since nesting material is not carried but is used where it is found, the birds must build where the ground is sufficiently muddy to be readily worked. The first group of nests seen by us in 1902 was placed on a sand-bar several yards from the nearest vegetation. As has been indicated, we also found nests among a dense growth of large mangroves.

When not disturbed the birds evidently return to the same locality year after year. In the region under consideration nine groups of nests were found within a radius of a mile, all apparently constructed in different years, since they appeared to be in different stages of decay.

Possibly when the governing conditions of any two years are alike, old nests may be repaired, but I saw no nests which seemed to have been rebuilt or added to.

The main portion of the 1904 nesting ground was irregularly triangular in shape and, measuring 60 x 115 x 120 yards, contained approximately 3450 square yards. The nests averaged about 50 to each one hundred square yards, making a total of 1725 in the main body of the rookery. To this number should be added numerous outlying nests, including a group placed among the mangrove rookery of 1901, bringing the total of occupied nests to about 2000.

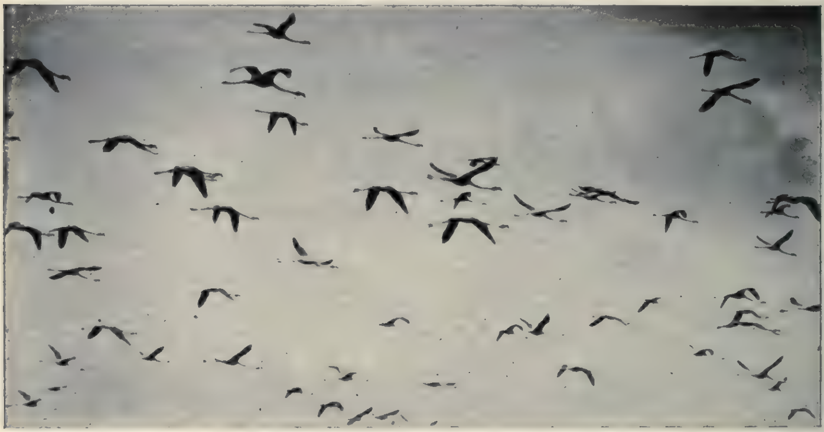

Fig. 2. Leaving the Rookery when alarmed.

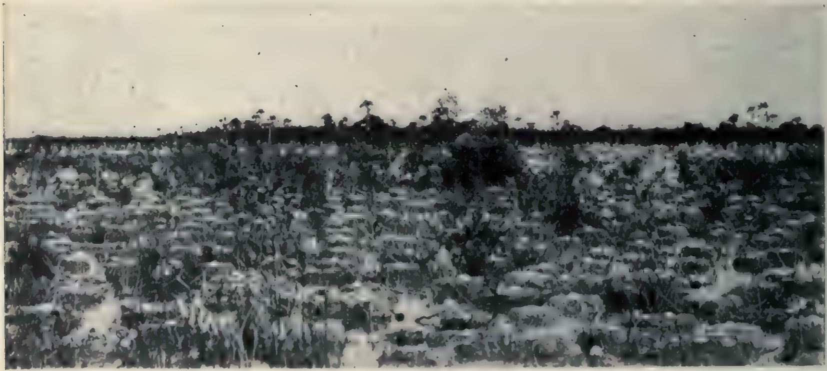

Fig. 3. The Deserted Rookery. The nests are all surrounded by water; the Flamingos have retreated to the background; the blind from which observations were made may be seen in the bush near the center of the picture.

The nest. — While I did not see Flamingos actually building their nests, I saw them adding to nests in which the egg had already been laid. Standing with a foot on each side of the nest mud was dragged up the side of the nest with the bill and pressed into position with both bill and feet. Doubtless the method was similar to that employed in building a new nest. My observations did not confirm Mr. Maynard's statement (Birds Eastern North America, 1896, p. 109) that the mud is not gathered at random but from two or three pits. When the nature of the ground permitted mud appeared to have been gathered from all about the nest. When, however, outcropping limestone limited the supply a comparatively large pocket might be scooped at some point where the absence of rock permitted a deeper excavation.

The material of which the nest is composed depends, as one might suppose, upon the nature of the spot in which it is built. The nests of 1902, placed on the marl bar, were composed wholly of marl; but under other conditions leaves, roots, and twigs may enter into the composition of the nest to a greater or less extent, and I saw several nests in which sticks played as prominent a part as mud.

The 1902 marl bar nests, which were then, I am told by Mr. Matthews, four years old, had evidently been so washed and weathered that the measurements made of them give a misleading idea of the dimensions of the fresh nest.

In the latter, as the following measurements show, there is more variation in height than in diameter. Thus six nests selected to show the range of variation measured in situ:

Diameter at Base.	Diameter at Top.	Height.
457 mm. (18 in.)	305 mm. (12 in.)	127 mm. (5 in.)
508 " (20 in.)	305 " (12 in.)	294 " (11 in.)
508 " (20 in.)	330 " (13 in.)	330 " (13 in.)
508 " (20 in.)	356 " (14 in.)	294 " (11 in.)
508 " (20 in.)	356 " (14 in.)	229 " (9 in.)
584 " (23 in.)	330 " (13 in.)	294 " (11 in.)

The average depth of the concavity holding the egg was one inch. There was no nest lining.

Nests were frequently placed so near together that they touched each other, but the average space allotted to each nest is two square yards.

The necessity of building a nest of some height was well illustrated during my stay at the 1904 rookery. Continued heavy rains flooded even the comparatively high ground on which the nests were placed, when every nest became an islet and numbers were submerged. The nests were then water-soaked masses of mud, and I experienced much difficulty in removing entire specimens in this condition.

The egg. — Of the nearly 2000 occupied nests examined only two

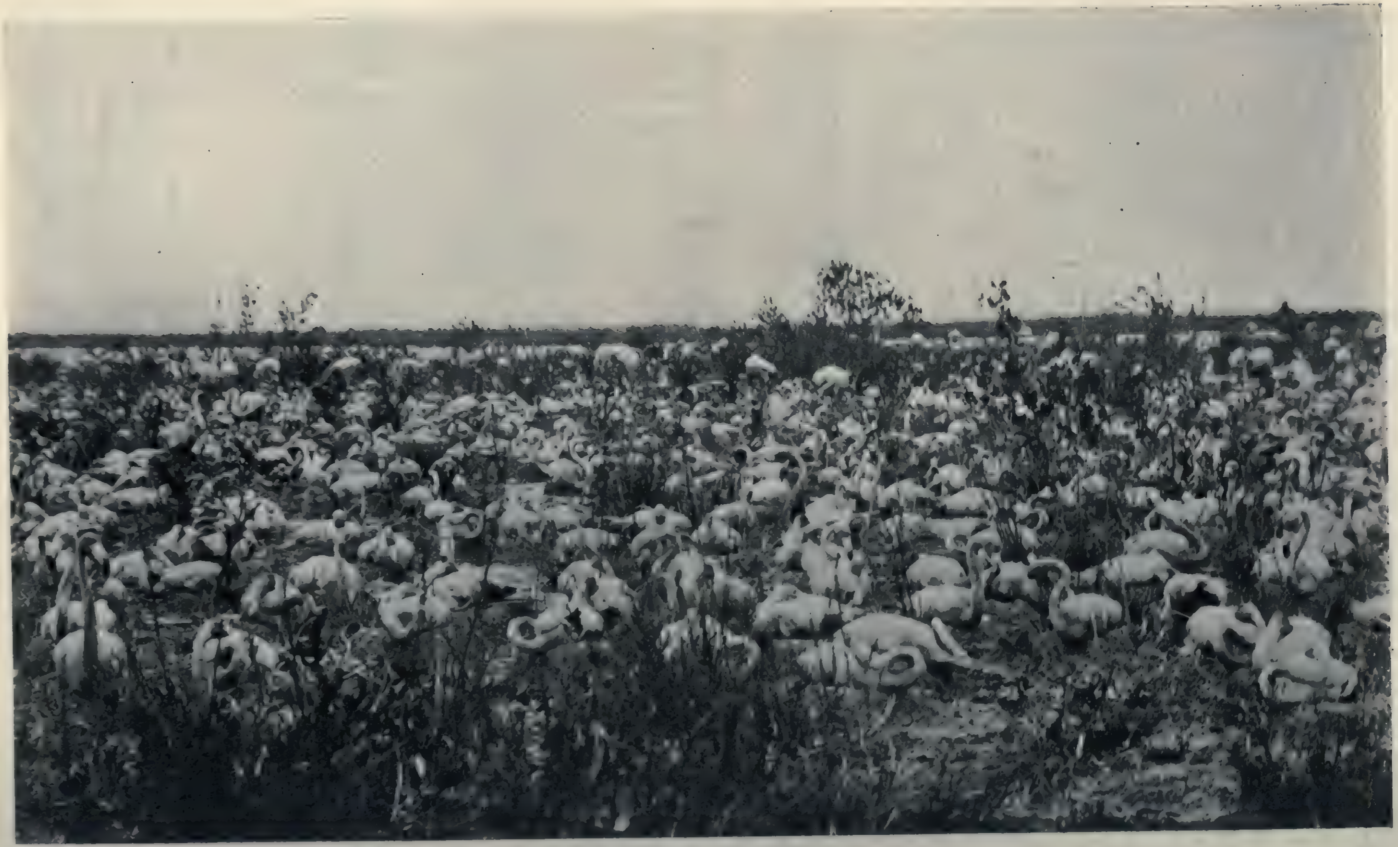

Fig. 4. Incubating and Sleeping.

contained two eggs, the remainder containing either one egg or one young each. The extreme rarity of two eggs in one nest induces the belief that in the instances noted they had possibly been laid by two birds.

Ten eggs measure (in millimeters) as follows: Average, 90.2 × 53.9; shortest, 82.4 × 52.4; narrowest, 90.9 × 49.3; longest, 97. × 53.3; widest, 90 × 58.

Incubation. — The period of incubation was not ascertained. Doubtless it approximates four weeks. Dissection showed that incubation is performed by both sexes. Only one of the pair, however, is present at the same time, my observations in this regard differing from those of Sir Henry Blake, who states (*l. c.*) that "the hens sat on the nests" while "the male birds had . . . all got together." The birds changed places early in the morning and late in the afternoon. They left or returned to the rookery singly or in flocks containing as many as fifty birds. The individual, therefore, which incubated or cared for the young during the day fed at night, while the one which had been feeding during the day passed the night in the rookery.

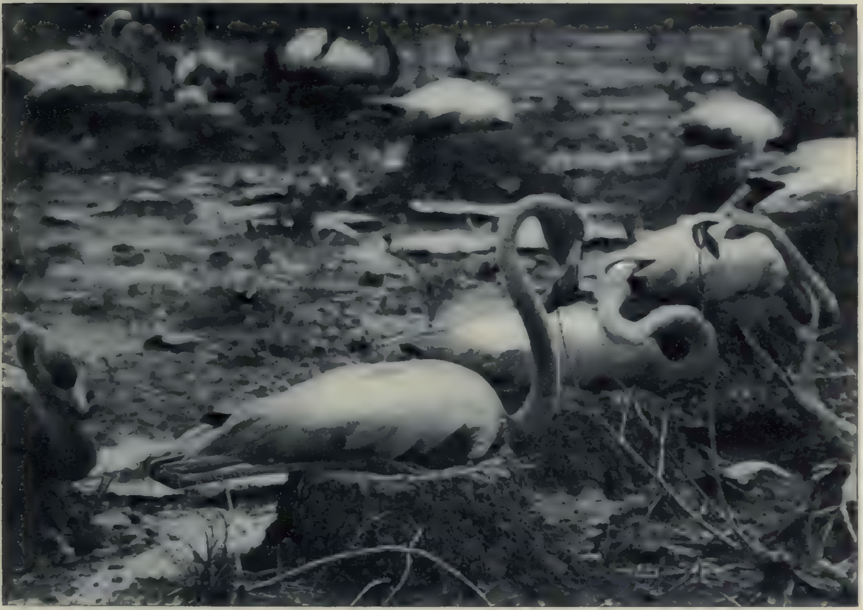

Fig. 5. Showing Pose of Incubating Bird. The birds in the background are 'sparring.'

There was no relation between sex and the time of day occupied in parental duties, both sexes being represented during the day and hence, doubtless, during the night also.

As the egg pipped the parent bird was seen to stand over it and move it with the bill until the opening was uppermost, thus giving the hatching chick access to the air.

When incubating, as has been stated by Johnston, Chapman, Maynard, and Blake (*l. c.*), as well as when brooding, the bird sits upon the nest with the legs folded. In assuming this position, the bird first stands upon the nest with its toes on the rim, then drops forward, the toes remaining at about the same point, while the heel projects slightly beyond the tail, and the tarsus is visible for the entire length. The attitude is typically represented in Figure 5, page 61. In arising the bill is pressed into the side of the nest and for a moment thus forms a tripod with the legs.

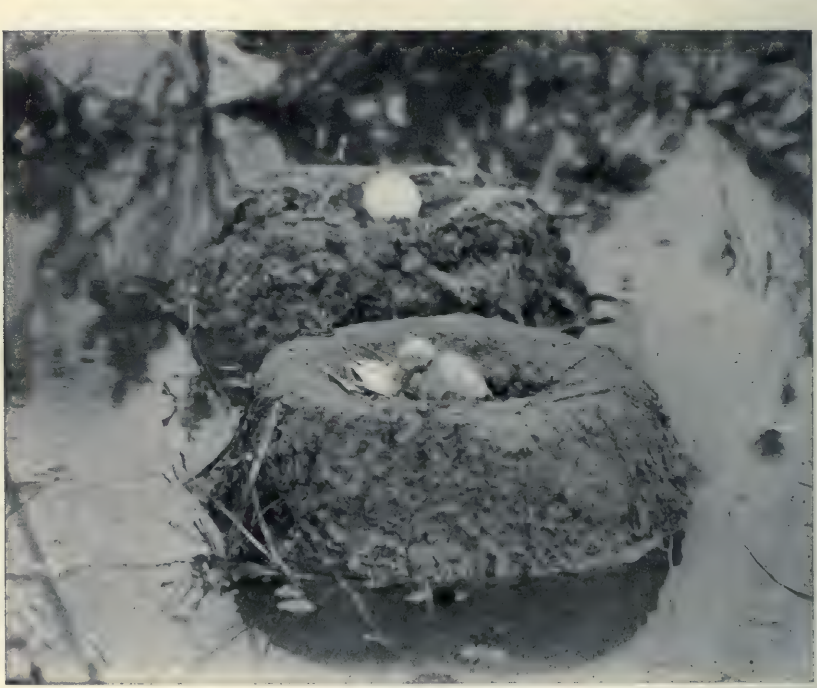

Fig. 6. Newly-hatched Chick.

The young bird. — The young Flamingo when hatched is sufficiently developed to leave the nest before it is dry, under the stimulus of an apparently instinctive fear. At my approach young birds with the plumage still wet from the egg would crawl over the edge of the nest and fall to the ground or water below, when their strength seemed to fail them.

A few hours later, when the plumage was dry, chicks could swim and run readily, and when they were a day old they invariably left the nest as I drew near.

When not disturbed the young remain in the nest three or four days. During this time they are brooded by the parents.

Their food consists of a blackish liquid, doubtless the juices of partially digested *Ceritheum*, which they receive from the parent's bill, a drop at a time, by regurgitation. The parent administers food while standing over the chick with lowered head and neck, or while brooding it, when the head of the young appears from beneath the parents' wing between the body and the humerus. Food was generally given in response to the young bird's open-mouthed appeal, and its administration was preceded by movements of the neck which evidently assisted the act of regurgitation.

While in the nest the young bird eats also the shell of the egg from which it was hatched. This soon becomes broken into small pieces which are readily picked up by the then straight-billed chick, doubtless with greater facility than its bent-billed parent could exhibit. This shell-eating habit appears to be invariable. Numerous chicks were seen exhibiting it, and egg-shells were found in the stomachs of the nearly twenty young examined. Possibly the development of this habit may be due to the limited nature of the parent's food, together with the fact that heavy rains may not only place the chick upon an islet but submerge available feeding areas. Consequently it is important that the food furnished by the parent be supplemented by a supply of bone-forming material which the chick finds in the nest.

The young bird evidently continues under the care of the parent after leaving the nest and, for a time at least, is still fed by regurgitation.

Young birds two days old, which jumped from their nests near my blind as I entered it, found their way home in response to the call of the parent and climbed back into the nest with the aid of bill, wings, and feet, without assistance from the parent.

When not guided by the parent, chicks which had left the nest prematurely and were attempting to return to it, apparently recognized neither their nest nor parent. They endeavored to climb up the nearest nest on which an adult was sitting, but were not welcomed; threatening, sinuous gestures of the long neck being followed, should the chick persist, by a slight nip on the nape, when the lost young bird continued in its search for home.

When leaving the rookery I took with me a number of young Flamingos, eight or ten days old. Birds at this age were so wild they could not be satisfactorily studied, nor did these chicks ever cease to show some signs of fear. On reaching Nassau they were placed in a small pen provided with a miniature pool.

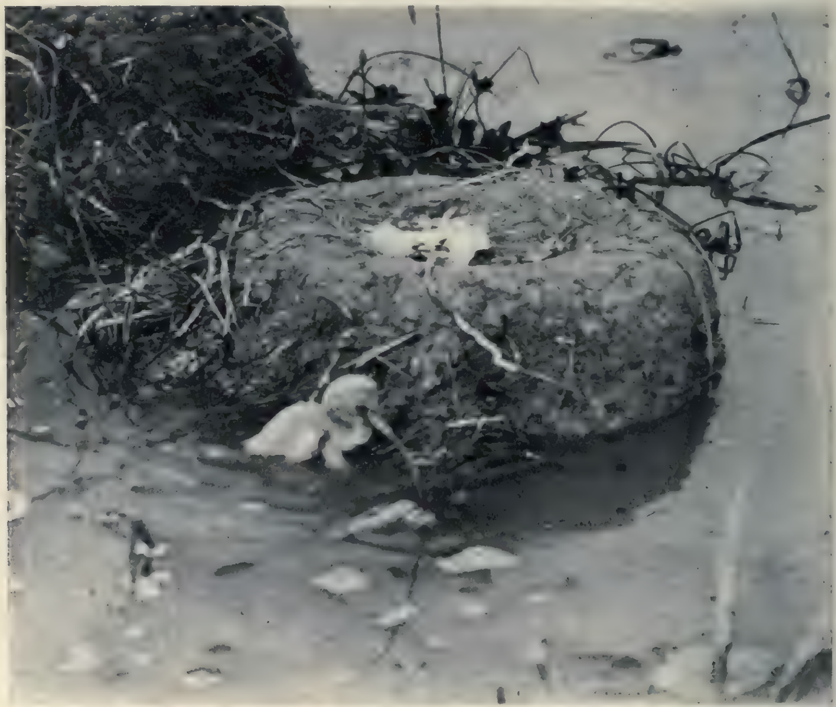

Fig. 7. Newly-hatched Chick, which left the nest before the plumage had dried, under the impulse of fear.

The upper mandible had now begun to show some convexity of outline and this change in form was correlated with a change in the manner of feeding, which now resembled that of the parent. When hominy or rice was placed in their artificial pool the birds secured it by slightly pressing the upper mandible into the mud, with which it was then nearly parallel. This portion of the bill was then moved rapidly, and at each contact with the lower mandible (in position now the upper), or, in other words, as the bill was closed, a little jet of water spurted from each side of it at the base. The action of the upper mandible, therefore, seems designed to force the mud and water through the strainers with which the sides of the bill are beset.

It was of much interest to observe that when the hominy or rice was too deeply imbedded in the mud of the pool to be readily secured in the manner described, the young birds 'danced' as do the adults under similar circumstances. That is, by a shuffling or treading motion of the feet, the food was floated or loosened so that it could be taken into the bill. The operation could be most satisfactorily observed by placing food in a flat-bottomed tin pan containing about two inches of water. It being impossible for the birds to press the bill into the bottom of this receptacle, on entering it they at once 'danced' and quickly caught the floating food. Since old birds did not often feed about the rookery it seems probable that the development of this method of feeding is instinctive.

These young birds often went through the motion of feeding one another, and this act was always accompanied by a rattling call uttered on no other occasion. The nature of the performance is illustrated in Figure 15, page 74. No food appeared to be administered at these times, and the habit may simply have expressed an instinctive desire for feeding by this method which, in the absence of the parent, may have been appeased by the attentions of a young bird. The fact that one bird would often have to beg its companion for some time to satisfy its wants before the apparently reluctant companion yielded, supports this suggestion.

Three of these young birds were brought to New York, arriving July 4, and were given comfortable quarters in the country where, however, they survived only about two weeks. In spite of the fact that they had now been in captivity nearly a month they still always attempted to escape when approached. It was exceedingly interesting to observe that when released on a lawn bordered by high, uncut grass, they not only made no attempt to conceal themselves in the cover the grass afforded, but could not be driven into the grass, where they seemed instinctively to know they would soon trip and be captured.

The notes of the young birds varied with age. When a few hours old their call suggested a puppy-like barking. This was soon followed by a squealing, whistling crow, which, in chorus, produced a shrill volume of sound plainly audible at our camp, a mile from the rookery, day and night, under favorable conditions of wind.

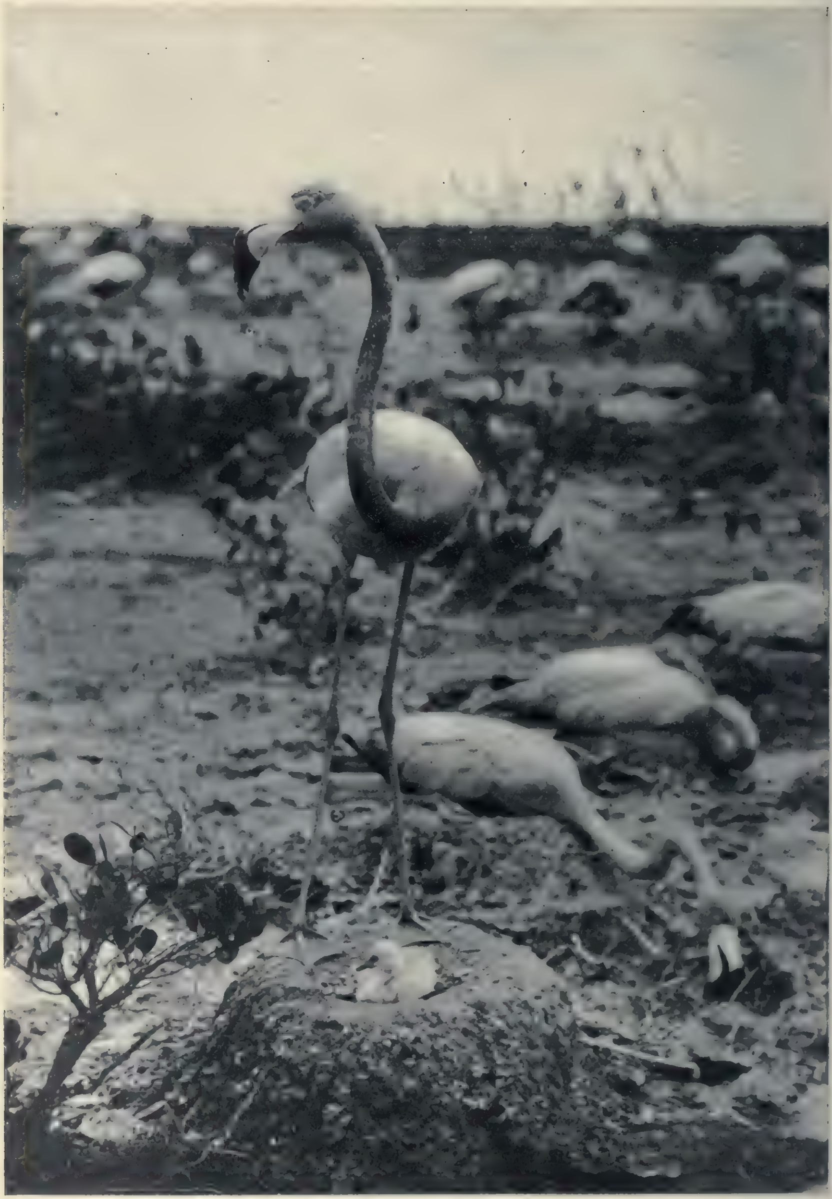

Fig. 8. Chick (about one day old) and Parent.

At the age of from ten days to six weeks or more the characteristic call is a chirruping crow, delivered in response to almost any stimulus. The birds also now uttered a long-drawn *c-a-a-r* and the rattling call mentioned above as an accompaniment to feeding.

The adult. — In leaving the rookery at my approach the adults all faced the wind and ran a step or two before springing into the air. When arising from the water they also patter a few steps over the surface before taking wing.

After taking refuge in the lagoon a return to the rookery was always preceded by a flight over it; then, after re-alighting in the lagoon, the rookery was entered on foot. At such times the birds all called their usual goose-like *huh-huh'-huh*, creating a deafening uproar. There was, however, no confusion, each bird going to its own nest with a certainty that implied definite recognition of its location.

Before the egg was hatched the birds seemed to sleep while incubating, and during my first days at the rookery the whole colony of birds was observed sleeping, and at such times not a note would be heard. With the appearance of the chick less time was devoted to sleep and the parents were much more noisy, often apparently calling to their chicks over which they stood, or leaned down to caress.

As might be imagined from the terms of intimacy on which, of necessity, they live while nesting, the birds did not appear to be pugnacious, their exhibitions of anger being confined to threatening movements of the head or a harmless grasping of bill by bill.

Wounded Flamingos, even when but slightly injured, make no attempt at self-defence, being, in this respect, wholly unlike Herons or Cranes, whose method of feeding doubtless prompts a vigorous use of the member which serves so well as a weapon when capturing their natural prey. The Flamingo's fare of shells and grubbing manner of feeding gives him no hint of the power which lies in his bill should he attempt to use it in defence.

The stomachs of all the adults examined contained only the remains of shells of the genus *Ceritheum*, which are evidently swallowed entire and ground up in the stomach, the walls of which are exceedingly thick and muscular. The birds sometimes fed in water which reached to their bodies, and the treading or dancing motion, which has been well described by former writers,[1] was employed while the head was submerged.

I did not observe that either while feeding or when in the rookery the birds posted sentinels, as has been stated. The loud note of

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[1] See especially Ingraham, World's Congress on Ornithology, 1896, pp. 59–69.

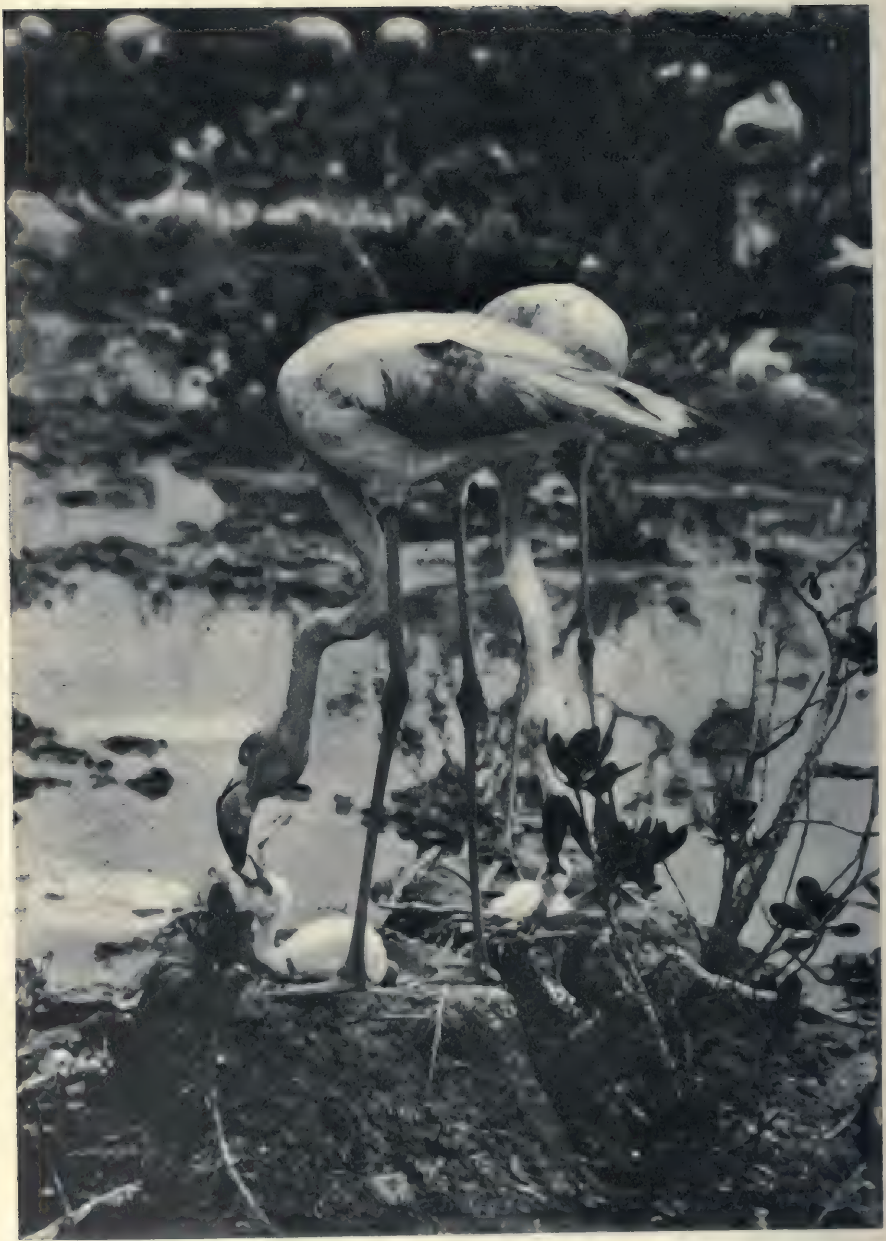

Fig. 9. Feeding by Regurgitation.

alarm seemed to come from any part of the rookery, and was immediately taken up and repeated by bird after bird. Should its cause increase the birds soon began to arise, and shortly every bird in the colony would be standing up. If the alarm proved to be unfounded they all dropped back on their nests, but if it was occasioned by a real or supposed source of danger the front or most windward birds took wing first and were followed by those behind them.

On returning to its nest from which the chick had been frightened the parent was observed to call evidently for its missing young. In one instance, although the young did not appear, the parent resumed its place, sitting on the empty nest.

The notes of the adults are varied in character. The commonest is the loud *huh-huh`-huh*, already mentioned, the second syllable of which is strongly accented. This call was given in a low, deep tone and in a higher one of less volume, a difference which I considered sexual, the louder voice being, presumably, that of the male. This was the alarm call, and indeed was heard whenever there was any commotion in the colony. Other calls were a deep nasal, resonant *honk*, *honk*, *honk*, *honk*, even more goose-like in tone than the first call mentioned, a hen-like, drawled *cah-cah-cah-cah*, and a broken *cut-leèk*.

Mortality among Flamingos. — Aside from man, Flamingos in the Bahamas appear to have few enemies. The absence of predaceous mammalia, the comparative scarcity of large reptiles and birds of prey, together with the abundance of food, make certain portions of these islands ideal resorts for these non-adaptive, defenceless birds.

The Turkey Buzzard was the only natural enemy of the Flamingo which I observed, and I did not actually see it in the act of eating Flamingo eggs or young. The penetrating chorus of *huh-huh`-huhs* which arose every time a Buzzard sailed over the rookery, the fact that in the Bahamas food for Buzzards is not apparently abundant, and the testimony of Mr. Matthews show that the Buzzards do feed upon Flamingos' eggs and even young birds.

My experience, however, leads me to believe that, aside from attacks by man, the heavy rains of the tropics are doubtless the chief cause of mortality among Flamingos. As has already been mentioned, the first occupied rookery discovered was completely wrecked by a deluge of rain; and even the nests on the ground, high enough to have escaped submergence during the first storm, eventually were flooded. All the nests in the second rookery were surrounded by water when I left, some were under water, and the continuance of the rain doubtless destroyed others. From May 17 to June 15, the rainfall,

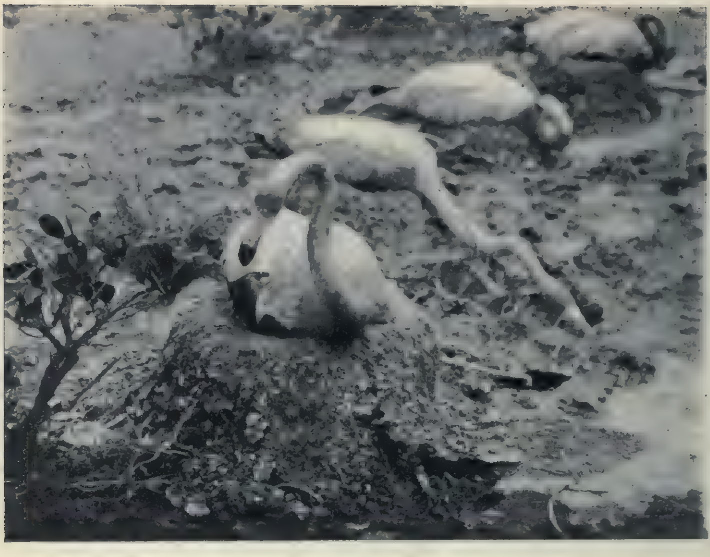

Fig. 10. Brooding, and Feeding by Regurgitation.

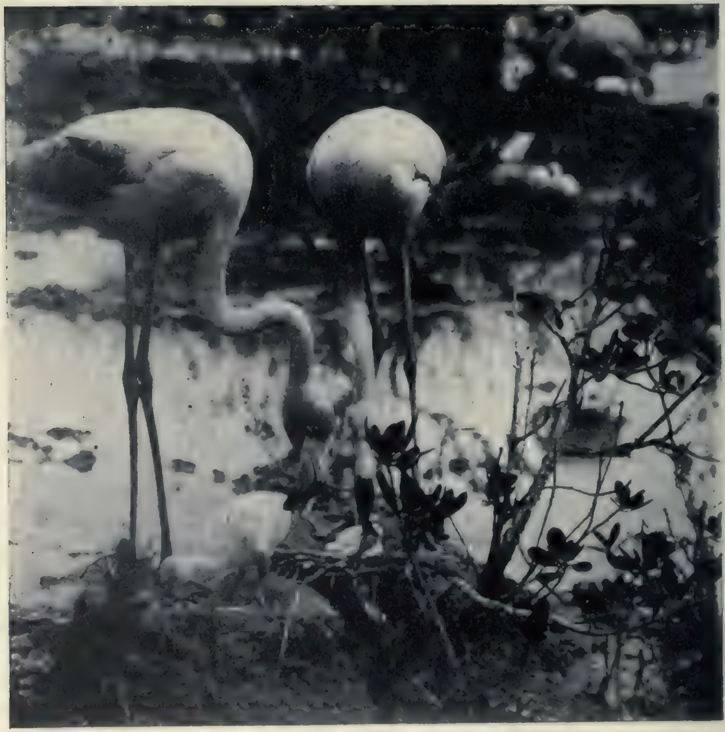

Fig. 11. Chick Eating the Egg-shell.

as recorded by the resident justice of the island on which the birds nested, was 20.26 inches. The season, however, was exceptional, and it is probable that during many seasons the Flamingos do not suffer from climatic influences.

But at all times they are subject to attack from negroes, who are not only their worst enemy but the only enemy apparently threatening their continued existence in the Bahamas. With their usual improvidence, the negroes not only take the young birds but the eggs as well. Their especial aim is to visit the rookery in July when the young are about half-grown. Placing in brine all the birds which cannot be disposed of while fresh, there is no limit to their demands.

On the island of Abaco the diminution in the numbers of this species appears to have been especially marked. The colony observed by Governor Blake on this island, in 1886,[1] was said by him to contain seven hundred to one thousand birds, but Bonhote, writing in 1903,[2] states that he "could not ascertain for certain" whether the Flamingo still existed on Abaco, and G. M. Allen, who visited the island in 1904, found only one flock of fifty-four birds.[3] The last-named writer states that the species is "subject to constant persecution by the natives." It is apparent, therefore, that unless some measure be taken to protect Flamingos during the nesting season they will continue rapidly to decrease in the Bahamas.[4]

REMARKS ON SPECIMENS.

First downy or natal plumage. — Lacking material for a comparative study of the pterylosis and feather structure of the Flamingo, I present here only a description of its plumages.

At birth the Flamingo is thickly covered with down which, when released from its waterproof sheaths, is thickly and uniformly distributed over the body. The lores and orbital region are bare, and only the upper half of the tibia is feathered. In general this down is snowy white, with a tinge of bluish gray upon the back and crown. The latter color is variable, sometimes, though rarely, being virtually absent; at others being so strongly developed as to become well-pronounced slaty-gray. (See specimen No. 1, Fig. 16.)

Second downy or post-natal plumage.— This plumage is represented by specimens taken alive which died in captivity. The wear of cage-life and the lack of proper nourishment have both acted, doubtless, to prevent the development of this plumage in a wholly typical manner; nevertheless the conclusions drawn from a study of these specimens are probably reasonably accurate.

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[1] Nineteenth Century, 1887, pp. 886–890; Ibis, 1888, p. 151.

[2] Ibis, 1903, p. 310.

[3] The Auk, 1904, p. 121.

[4] Since the above was written I am glad to be able to add that a law establishing a close season on Flamingos, from April 1 to October 1, has been passed by the Bahaman Assembly. While this law, from the nature of the case, will be difficult of enforcement it should at least prevent the wholesale destruction and open sale of young Flamingos which has heretofore prevailed.

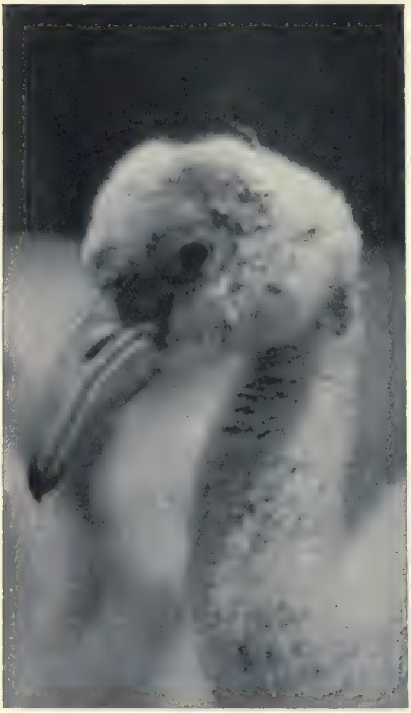


Fig. 12. Head of a Flamingo about two weeks old, showing the beginning of the curve in the mandible.

This second downy plumage is shown by chicks about one month old which had been in captivity nearly three weeks. In general color it is uniform ashy gray. Examination shows that this second down succeeds the first by continuous growth; that is, for a time the first or white down appears at the tip of the second or gray down, a constriction at the base of the former and tip of the latter marking the point of attachment.

Material is lacking to show the significance of this second downy plumage or its bearings on the relationships of the Flamingo. An apparently similar plumage is shown by young Swans, but I have not a sufficient number of specimens to warrant the treatment of this question at present. (See specimen No. 2, Fig. 16.)

Third or juvenal plumage. — The Flamingo's third plumage, like the second, is evidently acquired by a continuous growth of the shaft which supports both the first and second plumages. As before, therefore, a vanishing plumage appears for a time on the tip of the feather which is pushing it outward. The point of attachment, however, between the base of the second plumage and the tip of the third is marked by a constriction such as exists between the first and second plumages, only when it emerges from its papilla. The constricting sheath quickly disappears and the gray down of the second plumage then appears as a marginal fringe bordering the entire terminal portion of the growing feathers of the third plumage.

This plumage consists of fully formed feathers. It first appears

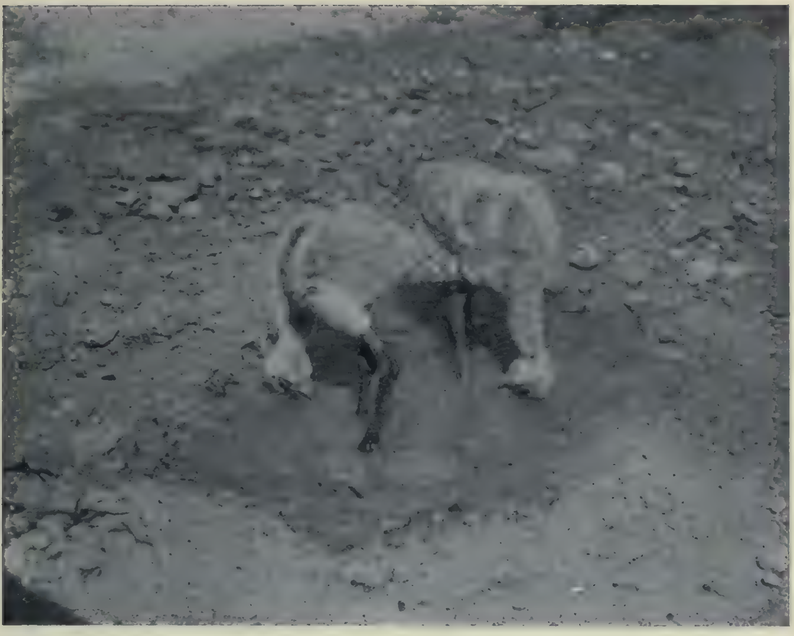


Fig. 13. Young at the age of about two weeks, feeding after the manner of the adult.

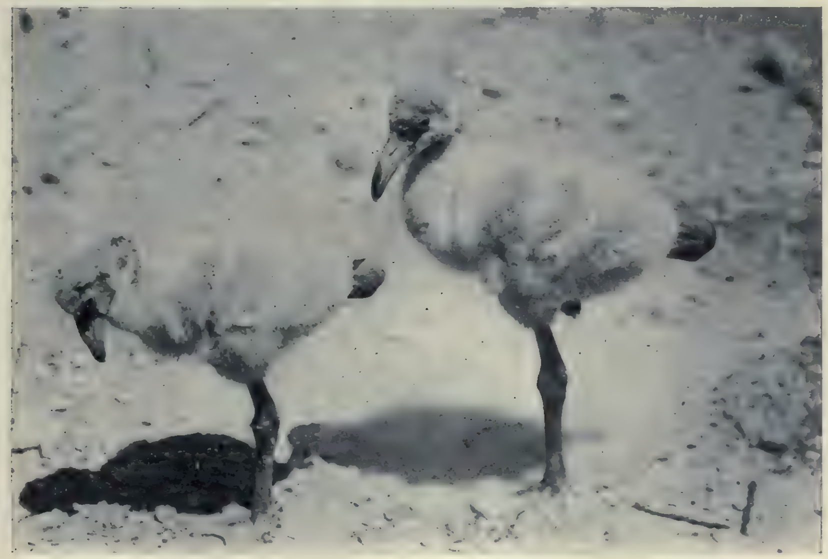


Fig. 14. Young at the age of about two weeks, in the pose of the adult.

upon the *pteryla humeralis*, and a little later is seen upon the anterior lateral branch of the *pteryla ventralis*. Judging from specimens which were brought from the Bahamas to the New York Zoölogical Society, and which on dying there about August 1 were presented to the Museum, and from living specimens brought home by myself, this plumage begins to appear at about the age of five weeks. When fully developed, as it is in a specimen (No. 11392) from Cuba, which died in the Central Park Menagerie, New York City, September 28, 1896, the general color is grayish brown with a tinge of pink upon the underparts and wings. The feathers of the back have well-marked black shaft-streaks; the tail is pale pinkish white, externally edged with blackish; the primaries are black, the secondaries black internally margined with white except at the tip; the primary coverts are all pinkish, blackish at the tip and on the inner vane; the lesser, median, and greater coverts are generally pinkish basally, blackish at the tip; the axillars are pink; the abdomen is pinkish washed with brown. (See specimen No. 4, Fig. 16.)

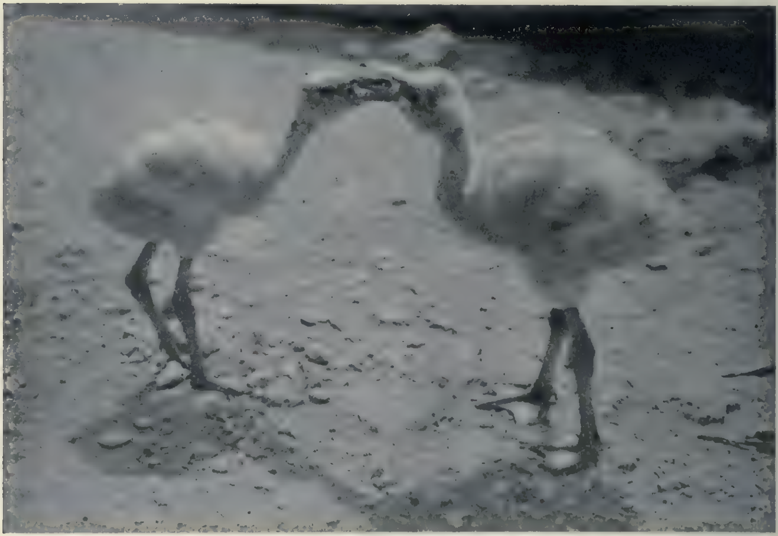


Fig. 15. Young Flamingos feeding each other.

Adult plumage. — The time of assumption of the adult plumage appears not to be known. On May 20, 1904, I saw a bird apparently in the third plumage just described; but with this exception all the Flamingos seen by me prior to June 1 were in adult plumage. I am led,

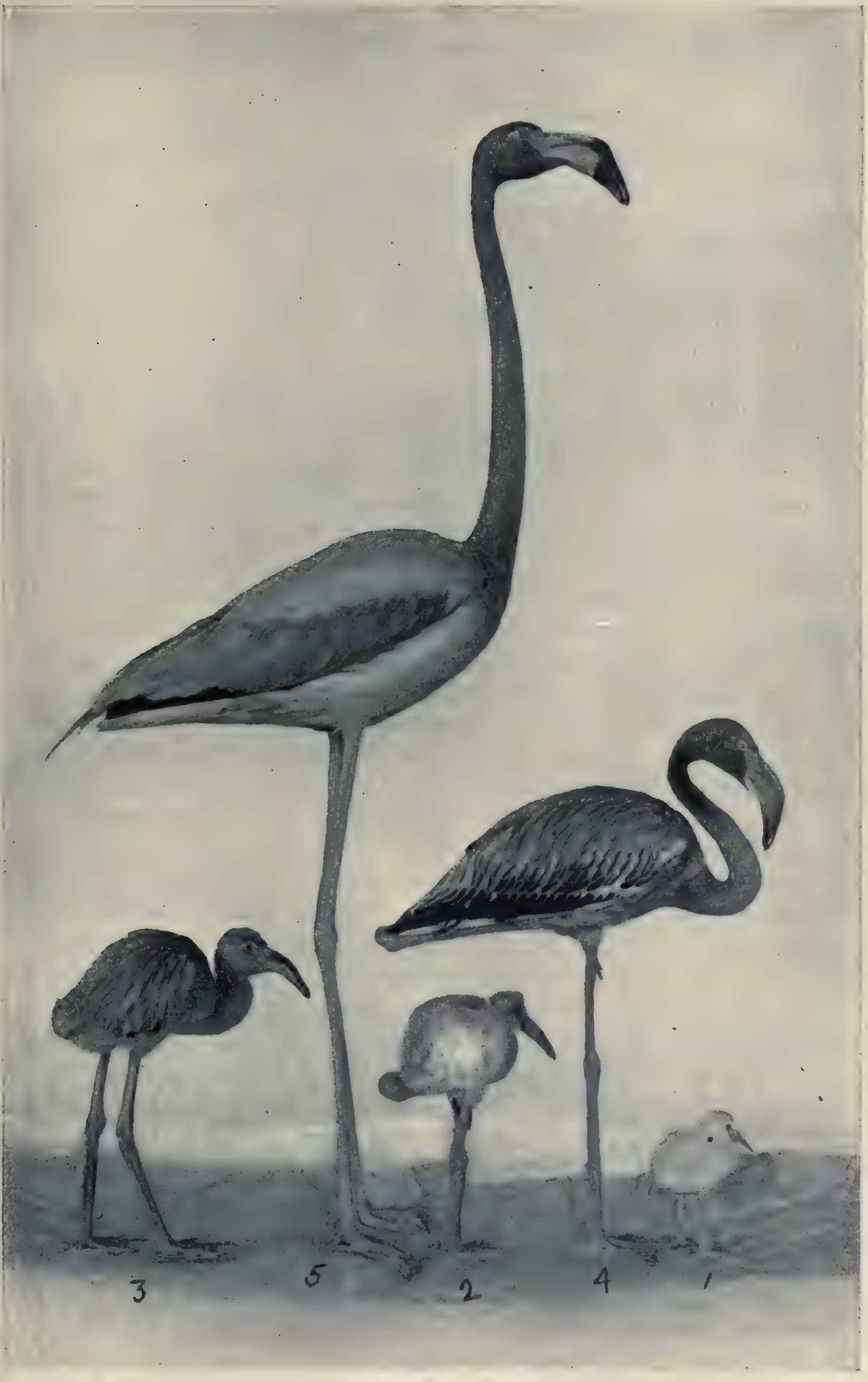


Fig. 16. The Growth of Flamingos. The approximate ages of the birds shown in the accompanying plate are: (1) One day; (2) one month; (3) two months; (4) four months; (5) adult. From mounted specimens in the American Museum of Natural History.

therefore, to infer that the mature plumage is acquired the first year of the Flamingo's life. In my opinion it follows the third plumage and is gained by a complete moult, perhaps in November or December.

Once grown it is evidently moulted once a year. The moult begins while the birds are still nesting. Specimens taken June 13 have new feathers appearing in numbers on the crown and scapulars.

At this time the old plumage is much worn and faded. The back, in some specimens, is nearly white, and the long scapulars are so abraded that little but the shaft remains on the terminal third. The upper and under wing-coverts, and especially the axillars, show less change than other portions of the plumage.

As far as I could learn from the usually inaccurate testimony of the negroes, the moult continues through July and part of August; the flight feathers being shed in the latter month.

The bill of the chick. — The outline of the upper mandible in the newly hatched Flamingo is straight. The ridge of the culmen is pronounced and extends to the unguis, which is well developed and abruptly bent downward, making a decided hook.

The lower mandible is straight, the tip, as in the adult, with converging sulcæ. Lateral serrations are barely evident on the upper mandible and are not present on the lower mandible, where they seem not to become evident until the chick is at least three weeks old; at which age the serration of the upper mandible is strongly marked.

The curvature of the bill, so characteristic of the adult Flamingo, is not suggested in the bill of the young bird until it is about two weeks old, when the upper mandible becomes slightly convex in outline. The downward bend now develops rapidly, perhaps in response to a change in the manner of feeding, and at the age of two months the bill is decidedly bent and the serrations of the sides of the upper mandible have become well-formed lamellæ.

Until the chick is eight or ten days old the bill, feet, and legs are flesh color; at the end of this time they become plumbeous.

Measurements. — The appended table of measurements of adult, immature, and embryonic specimens reveals several facts of interest. While there is a decided average sexual difference in size, a large female evidently may attain the size of a small male.

The extremes in total length, from the tip of the toes to the end of the bill, are represented by No. 87009, ♂, which measured 1727 mm. (approximately 5 ft. 8 inches), and No. 87104, ♀, which measured 1321 mm. (approximately 4 feet 4 inches).

Comparison of the measurements of embryos and immature birds with those of adults shows a surprising increase in the length of the tarsus, which, in the embryo, is but little longer than the middle toe and claw, and about one-tenth the total length of the bird; while in the adult it is nearly three times the length of the middle toe and claw and approximately one-fifth the total length of the bird. This striking difference in proportions suggests the inference that the Flamingo is descended from a short-legged ancestor, which the embryo and young of existing species also leads us to believe doubtless possessed a straight bill. Possibly the legs as well as the bill have developed in response to the demands of methods of feeding imposed by the limited character of the bird's food. This theory, however, is advanced with hesitation and may be invalidated by discoveries in relation to the food and feeding habits of other species of this family.

Mus. No.	Sex and age.	Total length from tip of bill to end of toes.	Tarsus.	Middle toe and claw.	Chord of Culmen.	Wing.	Tail.	Ratio of tarsus to total length.	Ratio of middle toe to tarsus.
87001	♂ ad.	1626	321	90	128	425	163	19	28
87007	♂ "	1651	328	89.5	129.5	405	164	19	27
87008	♂ "	1676	333	89	121	401	156	20	27
87009	♂ "	1727	343	89	130	408	151	19	26
87010	♂ "	1676	332	89	121	416	150	19	27
87013	♀ "	1549	298	78	129	398	144	19	27
87014	♀ "	1321	251	74	113	370	145	19	29
87015	♀ "	1600	320	87	128	408	149	20	27
87016	♀ "	1499	280	78	116.5	382	140	19	28
87032	Juv.	689	100	64	—	—	—	14	64
87033	"	490	73	58	—	—	—	17	79
87034	"	355	54	45	—	—	—	15	83
87035	"	325	35	30	—	—	—	10	85
87036	"	290	32	24	—	—	—	11	75
87037	"	300	30	22.5	—	—	—	10	75
87038	"	280	29	21	—	—	—	10	73
87070	Embryo.	137	14.5	11.5	—	—	—	10	79
87071	"	110	11	9	—	—	—	10	82
87072	"	91	9	6.7	—	—	—	10	74
87073	"	47	4.5	3.9	—	—	—	9	87

59.57.96 (729.6)

Article VIII. — THE ANTS OF THE BAHAMAS, WITH A LIST OF THE KNOWN WEST INDIAN SPECIES.

By William Morton Wheeler.

Plate VII.

The ant fauna of the Bahamas has remained all but unknown up to the present time. Only four species, so far as I am able to ascertain, have been recorded from these islands: Emery has mentioned *Pheidole megacephala* and *Tapinoma pruinosum*, and has described an interesting *Macromischa* (*M. pastinifera*) as occurring in the Bahamas, and Forel has added the description of another species (*M. lucayensis*) based on a single female specimen.

During May and June, 1904, the American Museum of Natural History organized an expedition to the Bahamas primarily for the purpose of enabling Mr. Frank M. Chapman to make a study of the habits and secure specimens of the American flamingo. I had the pleasure of accompanying Mr. Chapman on this expedition, for which Mr. Nathan Bill of Springfield, Mass., very generously placed his schooner, the *Gloria* at our disposal. Ants were collected in many localities on Andros Island, the largest but least frequently visited, and on New Providence, the best-known of the islands. Undoubtedly, had I been able to visit the islands outlying to the eastward and northward (Exuma, Abaco, etc.) I should have found several additional species or varieties; but those enumerated in the present paper in all probability fairly represent the ant fauna of the whole archipelago. They will, at any rate, constitute a basis for a future more detailed study of the taxonomy and distribution of these insects in the Bahamas.

Among the material collected I find only ten species new to science, and all of these are more or less closely related to well-known West Indian forms. Most interesting, perhaps, are two new species of *Macromischa*, a genus which seems to have its centre of distribution in the West Indies, a *Trachymyrmex*, a twig-inhabiting *Tapinoma*, and the rediscovery of *Camponotus inæqualis* originally described by Roger from Cuba. Several new subspecies and varieties are recorded, but a full appreciation of their value as geographical races must depend on a future biological survey of the whole Bahaman archipelago and the Antilles. As would be expected, there is a close affinity, amounting in many cases to identity, between the Andros and New Providencee ants with those of Cuba on the one hand, and those of Florida on the other. Certain species, however, like

Camponotus planatus, which are common in tropical Florida and presumably, also, in Cuba, were not seen in the Bahamas. The widely distributed 'fire ant,' or 'hormiga brava' (*Solenopsis geminata*), appears to be absent from Andros.

Owing to their peculiar geological formation there is little soil in the Bahamas. Hence it is not surprising to find a large proportion of their Formicidæ nesting in the cavities of plants. The following forms were found in hollow twigs, the culms of tall grasses (*Uniola paniculata* L.) and sedges (*Cladium jamaicense* Crantz), or between the scale-like leaves of the epiphytic Tillandsias on the trees and bushes of the 'coppets' and 'swashes': *Cremastogaster lucayana* and its subsp. *etiolata; C. victima steinheili; Monomorium floricola, M. ebeninum, Xenomyrmex stollii floridanus* var. *lucayanus; Macromischa splendens; Cryptocerus varians; Pseudomyrma flavidula* and *P. elongata; Tapinoma litorale; Camponotus zonatus* var. *eburneus; C. inæqualis* var. *ramulorum* and var. *marcidus*, and *C.* (*Colobopsis*) *culmicola*. The following are the more interesting observations on habits and structure briefly recorded in the notes appended to the taxonomic descriptions in the body of the paper:

1. The ergatomorphism of the females of *Monomorium floricola* and *M. ebeninum*.

2. The record of a mixed colony of *Pseudomyrma flavidula* and *P. elongata*, apparently formed by dulosis.

3. The nesting habits of *Macromischa splendens*. These have been observed in only two other species (*M. sallei* Guér. of San Domingo and *M. subditiva* Wheeler of Texas), and show great diversity within the confines of the genus.

4. The confirmation of my former observations on the fungus-raising habits of *Cyphomyrmex rimosus*.

5. The singular habits of *Colobopsis culmicola*, which nests in the culms of *Cladium*, unlike the other known species of the subgenus, which nest in wood or galls.

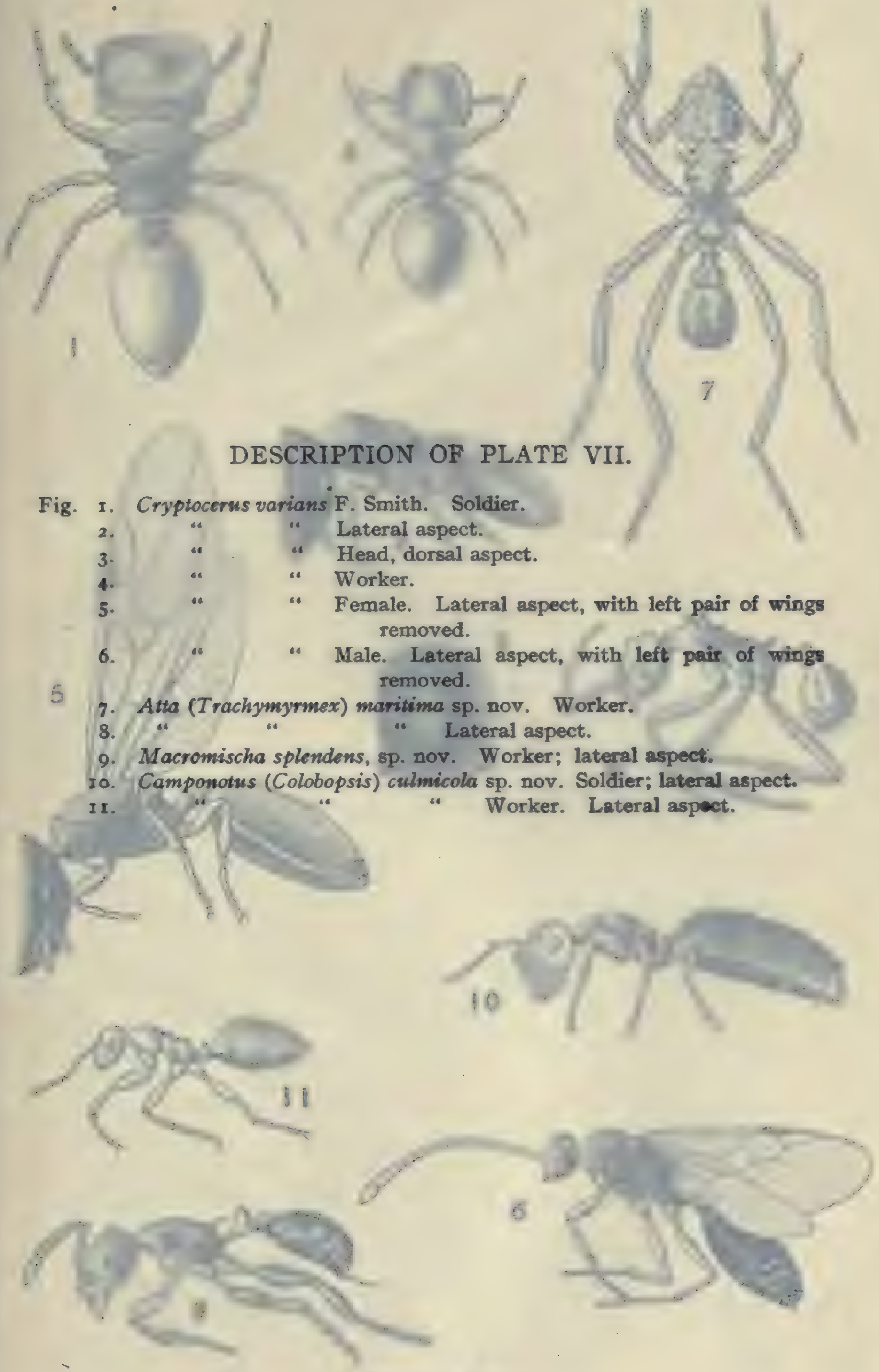
As an aid to further study of the West Indian Formicidæ, I have appended to the descriptions of the Bahaman forms a general list of the known species with bibliographical notes. Additional references to the literature on many of these species will be found in the seventh volume of Dalla Torre's valuable 'Catalogus Hymenopterorum.'

Subfamily PONERINÆ.

1. **Platythyrea punctata** *F. Smith*. — A single colony comprising about thirty individuals, with three winged females and several larvæ

DESCRIPTION OF PLATE VII.

Fig. 1. *Cryptocerus varians* F. Smith. Soldier.
2. " " Lateral aspect.
3. " " Head, dorsal aspect.
4. " " Worker.
5. " " Female. Lateral aspect, with left pair of wings removed.
6. " " Male. Lateral aspect, with left pair of wings removed.
7. *Atta (Trachymyrmex) maritima* sp. nov. Worker.
8. " " " Lateral aspect.
9. *Macromischa splendens*, sp. nov. Worker; lateral aspect.
10. *Camponotus (Colobopsis) culmicola* sp. nov. Soldier; lateral aspect.
11. " " " Worker. Lateral aspect.



Bahaman Ants.

Camponotus [illegible] Florida and presumably, also in Cuba were not [illegible] The widely distributed 'fire ant' or [illegible] appears to be a[illegible]

Owing to their [illegible] the Bahamas [illegible] of their Form[illegible] forms were fo[illegible] *paniculata* L., [illegible] the scale-like [illegible] the trees and bushes of the 'coppets' and [illegible] its subsp. *etiolata*; *C. victima steinheili*, [illegible] *splendens*; *Cryptocerus varians* [illegible] *elongata*; *Tapinoma littorale* [illegible] *inæqualis* var. *ramulorum* and [illegible] *micola*. The following are [illegible]

[illegible] and *M.* [illegible]*um*.

2. The record of [illegible]

F. elongata [illegible]

[illegible]

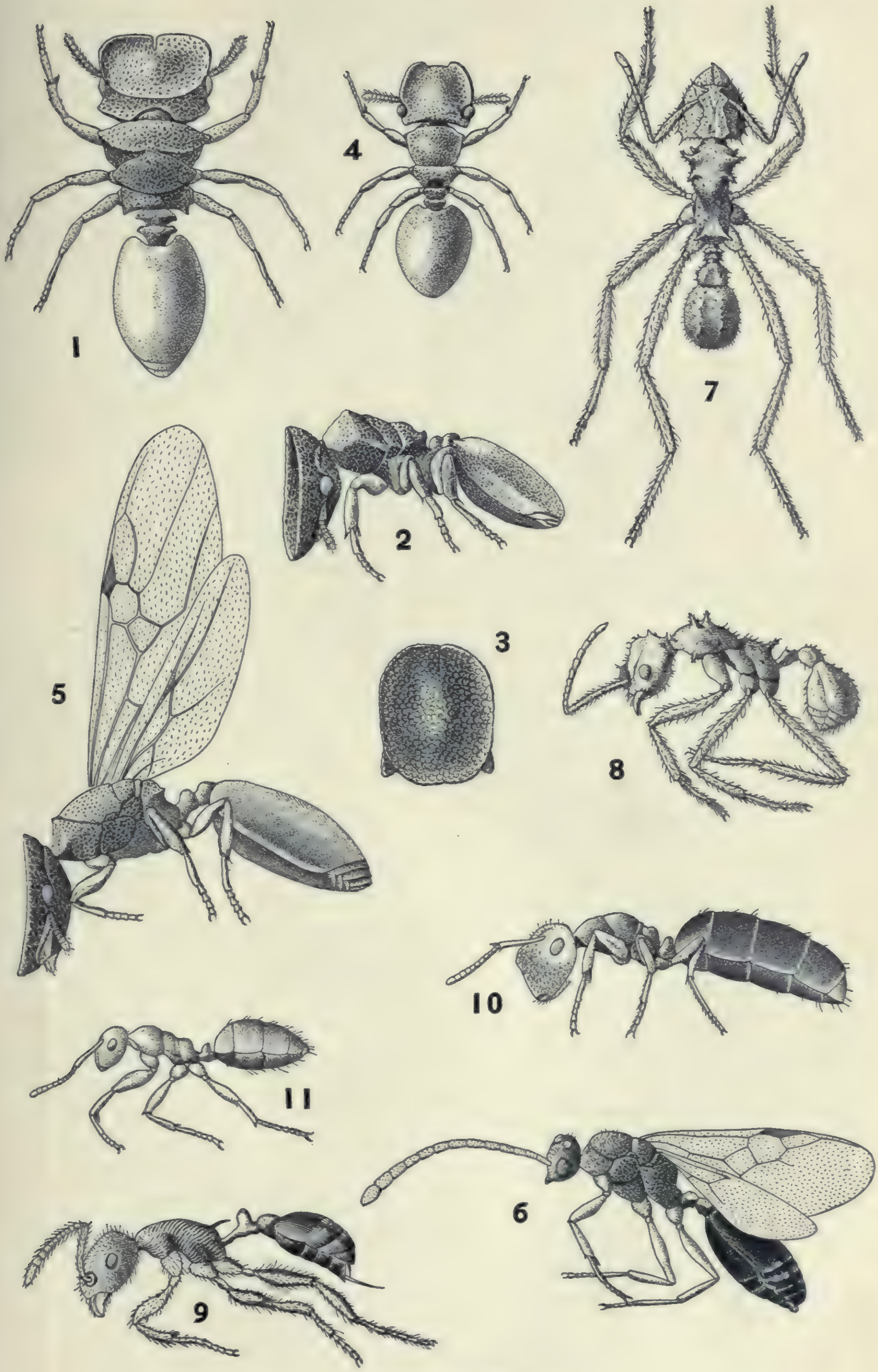
culmi[illegible]

which [illegible]

As an aid [illegible] I have appended to the descriptions of the [illegible] forms a general list of the known species with bibliographical notes. Additional [illegible] to the literature on many of these species will be found in t[illegible]

Subfamily PONERINÆ

1. **Platythyrea punctata** *F. Smith.* — A [illegible]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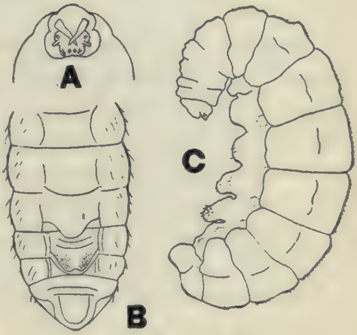
BAHAMAN ANTS.

and pupæ, was taken, June 23, in an outhouse on the quay at Nassau. The ants were living in a wooden box, the walls of which contained a termite colony. Some of the workers and females were yellow or deep ferruginous red. This peculiar coloration, which has been noticed by Forel (Rev. Suisse Zool., ix, 1901, p. 336), is due merely to immaturity; the color of the adults is always black. The larvæ exhibit certain peculiarities not hitherto described in the Formicidæ (Figs. A, B, and C). There are no pointed tubercles covering the body as in many other Ponerinæ (*Ponera*, *Pachycondyla*, *Odontomachus*, etc.), and the hairs are much shorter and sparser than in certain other forms, like *Ectatomma*, *Stigmatomma*, and *Cerapachys*. There is a prominent rounded protuberance on the midventral surface of the fifth, and another on the corresponding region of the sixth abdominal segment. The latter protuberance is covered with yellow spinules. The head of the larva is unusually small, with rather feeble mandibles. The cocoon is cylindrical, pale yellow, and rather thin. Its posterior pole has a conspicuous black meconial spot.



Larva of *Platythyrea punctata* F. Smith. A, head ; B, ventral surface of abdomen ; C, whole larva, lateral aspect.

Forel is probably right in referring both *P. inconspicua* and *P. pruinosa* Mayr to Smith's species, which appears to be widely distributed through the West Indies (San Domingo, Jamaica, Barbados, Guadeloupe, Grenada, St. Vincent, and Cuba). Mr. C. F. Baker has sent me specimens from the island last mentioned (environs of Havana).

2. **Pachycondyla** (**Pseudoponera**) **stigma** *Fabr.* — Several colonies of this species were found on the keys along the course of the Southern Bight, Andros Island, and near the Blue Hills, N. P. The males and winged females were taken in the former locality during the latter part of May. The species, which seems to prefer the 'pine yards,' nests under stones or the bark of old pine stumps and logs in colonies numbering from a dozen to 75 or 100 individuals. The larvæ, which are tuberculate like those of *P. harpax*, and lack the glutinous dorsal tubercles of the species of *Ponera*, have been described and figured by Emery (Mem. R. Accad. Sci. Ist. Bologna, 1899, pp. 4, 5, Tab. I). *P. stigma* occurs also at Lake Worth, Florida, where specimens were collected by the late Rev. P. J. Schmitt, O. S. B.

3. **Ponera ergatandria** *Forel.* — A few workers taken at Nicholl's Town on the eastern coast of Andros Island, under cocoanut boles partly buried in the sand of the sea-beach.

4. **Ponera opaciceps** *Mayr.* — A deälated female and three workers taken under stones in the moat surrounding Fort Charlotte, near Nassau, N. P.

5. **Anochetus (Stenomyrmex) emarginatus testaceus** *Forel.* — A single colony of about thirty workers was found under a stone in the Queen's Staircase at Nassau. In his notes on these ants in St. Vincent, H. H. Smith says (Trans. Ent. Soc. London, 1893, p. 358) that they "wander about helplessly and rather slowly." The specimens I observed moved with great rapidity, and nearly all of them made good their escape into the grass.

6. **Odontomachus hæmatodes insularis** *Guérin* var. **ruginodis** var. nov.

To this variety I assign a small form of *O. hæmatodes*, which in color and pilosity resembles specimens of *insularis* taken in Florida (Lake Worth, Enterprise, Biscayne Bay, etc.). In the worker the head, antennæ, and legs are dark red, the thorax nearly black. The upper surface of the head and thorax is opaque and strongly sculptured. The petiole, which is sharply and transversely rugose on its anterior and posterior surfaces, is narrow, decidedly convex behind, with rounded sides, and passes rather gradually into the spine.

This variety was taken only on New Providence Island at Nassau (Queen's Staircase and Fort Charlotte) and a neighboring key, Hog Island. Specimens of the very same form have been sent to me from Havana, Cuba, by Mr. C. F. Baker. Florida specimens of *insularis*, like those of the next variety to be described, have only faint traces of the transverse rugæ on the petiole.

In Nassau I found the variety *ruginodis* nesting under stones in small colonies of often not more than a dozen individuals. In the moat of old Fort Charlotte several isolated females were seen starting their colonies. In this phase the petiole is much broader and much more rugose than in the worker.

7. **Odontomachus hæmatodes insularis** *Guérin* var. **pallens** var. nov.

The worker of this form differs from the preceding in the somewhat larger size, though it is smaller than the typical *hæmatodes*, its pale color, and the characters of the petiole. The head, antennæ. thorax, and petiole are ferruginous red, the legs yellow. The petiole is broader from side to side, but narrower anteroposteriorly, flattened or even concave behind, and passes above more abruptly into the long spine. It is shining, with only faint traces of rugæ on its anterior surface. In pilosity *pallens* resembles the var. *ruginodis*. The wings of the male are white, those of the female smoky.

This form was collected in several localities on Andros and New Providence Islands. It was common at Nicholl's Town, along Crawl Creek, on the keys along the course of the Southern Bight, and at Mangrove Key; on New Providence Island it occurred at Nassau, Fort Charlotte, Stanley (Menendez Sisal Plantation), Blue Hills, and West Bay. In several of these localities I took the males and winged females in the nests, May 18 to June 12. The nests are much larger than those of *ruginodis*, and often contain as many as 250 or 300 workers. They are flat and rather obscure mounds, one to two feet in diameter, built among the dead leaves in shady places, often about the roots of trees or shrubs. Sometimes the nests are found under stones or the trunks or leaves of palms. The workers of large colonies are very pugnacious and can sting severely. In one nest I found a very large Pselaphid myrmecophile, in another a peculiar myrmecophilous Blattid. The males, of which some colonies contained several, were sluggish and, like the males of *Pachycondyla harpax*, clung to the bottom of the stones covering the nest. I gained the impression that *pallens* is most frequently found in the 'pine yards,' that it is, in fact, one of the typical denizens of these forests. It occurs also in Cuba, whence I have received a number of specimens collected by Mr. C. F. Baker and Prof. C. H. Eigenmann.

Subfamily MYRMICINÆ.

8. **Pseudomyrma flavidula** *F. Smith.*

Worker. — Length, 3.5–5 mm.

Head, including mandibles, nearly twice as long as broad, slightly narrower behind than in front. Mandibles with two prominent apical and several smaller basal teeth. Eyes large, in front of the middle of the head, and nearly half as long as its sides. Clypeus slightly convex, longitudinally carinate in the middle; median lobe short, with a nearly straight anterior border, bounded on either side by a small notch. First joint of antennal funiculus much longer than broad, as long as joints 2–4 together; joints 2–10 about as broad as long; terminal joint as long as the three preceding joints together. Thorax slender, dorsal surface seen in profile rather flat, with pronounced but short mesoëpinotal impression. Pro- and mesothorax together as long as the epinotum, the basal surface of which is distinctly longer than the declivity; pronotum from above a little longer than broad, with rounded humeri and slightly but distinctly marginate sides; mesonotum transversely elliptical, meso-, and metathoracic stigmata prominent. Epinotum narrowed behind, rounded in profile. Petiole with a short peduncle, seen from above gradually broadening posteriorly, fully three times as long as broad, distinctly marginate along the sides above, so that the segment is triangular in cross-section. In profile the node rises very gradually and evenly from a slightly concave or flattened surface, and falls more abruptly behind where the dorsal surface is somewhat concave. Ventral surface with a small tooth near its anterior edge. Postpetiole from above pyriform, more than twice as broad as the petiole and more than three times as broad behind as in front, slightly constricted at its insertion into the gaster. Gaster slender, gradually tapering posteriorly. Femora somewhat incrassated.

Body shining, covered with very fine punctures, which are most distinct on the head and thorax.

Pilosity consisting of a very few scattered erect yellow hairs; pubescence white, very delicate, sparse, and inconspicuous.

Reddish yellow. Mandibles and clypeus whitish; eyes, teeth of mandibles, a large spot on either side at the base of the first gastric segment, and a minute spot at each ocellus black.

Female. — Length, 5.5–7 mm.

Very closely resembling the worker. The sides of the head are nearly parallel and the posterior corners are more prominent. Wings colorless, with very pale yellowish veins and black stigma. There is a small black spot above the insertion of the fore wing, and the tips of the hind femora are more or less infuscated.

Male. — Length, 3.5–6.5 mm.

Head elliptical, excluding the mandibles, longer than broad, contracted and rounded behind; cheeks very short, eyes and ocelli large. Mandibles well developed, with denticulate blades. Clypeus slightly convex, with a small, angularly projecting median lobe. Antennæ long, first funicular joint distinctly longer than broad, second joint three times as long as broad, fully as long as the scape; joints 3–10 subequal, twice as long as broad, terminal 1½ times as long as the preceding joint. Prothorax small, with concave sides; mesonotum broad, without Mayrian furrows; epinotum rather low and rounded. Petiole long and slender, laterally compressed but not marginate, ventral surface with a small tooth in front; peduncle long and slender, passing gradually into the wider posterior portion and low node, the anterior surface of which is flat and rises very gradually, while the posterior slope is more abrupt and slightly concave behind. Postpetiole somewhat shorter than the petiole, but twice as broad behind; its upper surface is flattened, its ventral surface more convex. Gaster enlarging and bent downwards towards the tip, with slender penicilli and prominent rounded external genital appendages. Legs rather slender, femora somewhat thickened.

Body subopaque, more shining on the dorsal surface of the head and thorax, which are very finely reticulate-punctate.

Pilosity and pubescence white, the former shorter, the latter longer and more abundant than in the worker, so that the surface of the body and appendages has a hoary appearance.

Dark brown or blackish. Mandibles, anterior half of head above and below, genitalia, sutures of thorax, and posterior margins of all the abdominal segments, pale yellow or whitish. Legs and antennæ pale yellow, the latter infuscated beyond the first joint of the funiculi, the former with the middle portions of the coxæ, tibiæ, and femora somewhat infuscated. Wings grayish hyaline, with brownish veins and black stigma. In many specimens the yellow posterior margin of the gastric segments runs forward into the middle of the infuscated portion, so that the latter becomes a bilobed spot.

Numerous specimens from many colonies collected on Andros Island (Fish Hawk Key, and many of the adjacent keys at the western end of the Southern Bight and Crawl Creek, at Mangrove Key and Dog Key); on New Providence Island at West Bay, Nassau, Hog Key, Blue Hills, Fort Charlotte, etc. In all of these localities the species was found nesting in the hollow culms of a tall grass (*Uniola paniculata* L.) and a sedge (*Cladium jamaicense* Crantz). The internodes of these plants were often packed full of the larvæ, pupæ, and callows. The adult workers were seen running about on the stems of the grasses and adjacent plants in search of small insects. The winged males and females were taken, May 23 to June 25. The females show considerable difference in size, some of them being veritable microgynes, no larger than the smaller workers.

9. **Pseudomyrma elongata** *Mayr.*

Worker. — Length, 3–4.5 mm.

Head, including mandibles, nearly twice as long as broad, as broad in front as behind, sides slightly convex, with the large eyes near their middle. Mandibles with two large apical and several very small basal teeth. Clypeus slightly elevated and carinated, with a very short lobe, broadly rounded in front, slightly produced, and bounded on either side by a small notch. Antennæ short, first funicular joint distinctly longer than broad, remaining joints, excepting the last, distinctly broader than long, last joint nearly as long as the three preceding joints together. Thorax slender, but little broader in front than behind; in profile the dorsal surface is rather flat, with a short but distinct mesoëpinotal impression. Pronotum longer than broad, with rounded humeri and flattened sides, hardly marginate. Mesonotum nearly circular. Epinotum about as long as the pro- and mesonotum together, somewhat narrower behind than in front, its basal surface flattened, not marginate, and nearly twice as long as the declivity into which it passes through a rounded angle. Petiole non-pedunculate, with a distinct tooth on its anterior ventral surface; seen from above it is a little more than twice as long as broad, broadest in the middle, triangular in cross-section, in profile with a rounded node, the anterior slope of which is more gradual and less convex than the posterior. Postpetiole pyriform, about as long as broad, and behind about twice as broad as the petiole, in profile equally convex dorsally and ventrally. Gaster broadest in the region of the second segment. Legs with slightly thickened femora.

Subopaque; surface of head and thorax densely and rather coarsely, legs and abdomen more finely, punctate; mandibles delicately striate-punctate.

Pile and pubescence white, the former very sparse and erect, the latter rather dense and conspicuous, giving the body a somewhat hoary appearance.

Dark brown or black; mandibles, antennal funiculi, clypeus, anterior margin of head, articulations of legs, tarsi, posterior edges of gastric segments, and tip of venter yellow or reddish yellow. In some specimens these lighter portions are more strongly infuscated.

Female. — Length, 5–6 mm.

Very similar to the worker. Head, excluding the mandibles, twice as long as broad, with parallel sides and rather prominent posterior corners. Sides of pronotum concave, leaving the edges above rather prominent and marginate. Epinotum rounded and somewhat convex. Tooth on lower surface of petiole very prominent. Wings grayish hyaline, with pale yellow veins and brown stigma. Mesonotum and scutellum smooth and shining.

Male. — Length, 4.5–5 mm.

Head, excluding the mandibles, longer than broad, rounded but not contracted behind. Cheeks very short. Eyes and ocelli large. Mandibles well developed, denticulate. Clypeus convex, angularly projecting forward in the middle. Antennæ long, with very short scapes; first funicular joint a little longer than broad, second joint longer than the scape, and longer than any of the succeeding joints except the last; joints 3–10 subequal, nearly 2½ times as long as broad, last joint nearly three times as long as broad. Thorax slender, broadest through the insertions of the anterior wings; pronotum small; mesonotum smooth, without Mayrian furrows; epinotum rounded but not swollen. Petiole with a short peduncle in front; seen from above slender, three times as long as broad, broadest behind the middle, in profile with a very low, rounded node and a small acute tooth near the anterior edge of its ventral surface. Postpetiole pyriform, longer than broad, behind more than twice as broad as the petiole; in profile flattened above, more convex ventrally. Gaster similar in shape to that of the worker, its tip not dilated nor deflected; penicilli long and slender, genitalia small and embedded, only the rounded tips of the outer valves being visible. Legs long and slender.

Head and thorax somewhat more shining than in the worker, owing to the smaller and more scattered punctures.

Pilosity and pubescence as in the worker, the hairs being short, erect, and abundant on the thoracic dorsum and rather conspicuous on the mandibles.

Dark brown; mandibles, basal antennal joints, anterior portion of the head except the middle of the clypeus, tarsi, and articulations of the body and legs, yellow; teeth of mandibles, genital valves, and penicilli, black. Wings as in the female.

Numerous specimens from the following localities on Andros: Dog Key, at the extreme northern end of the island; Pot Key and Fish Hawk Key in the Southern Bight, and Crawl Creek in southwestern Andros; Mangrove Key and Little Golding Key on the eastern coast. On New Providence Island the species was common at Nassau, Blue Hills, and Hog Key. Though it is found nesting, like the preceding species, in the culms of *Uniola* and *Cladium*, it seems to prefer the hollow twigs of bushes and trees like the gum mastic, sea grape, buttonwood, etc. The males and winged females were taken at the same time as those of the preceding species. Both species occur under very similar conditions on the Florida Keys and the adjacent mainland (Key Largo, Biscayne Bay, Card's Point, etc.). At Card's Point I found a number of colonies of *elongata* in Tillandsias. Near Blue Hills, N. P., I found a mixed colony of the two species in the same internode of a *Cladium* culm. A winged male, two winged females, and several workers of *flavidula* were living with several workers of *elongata*.

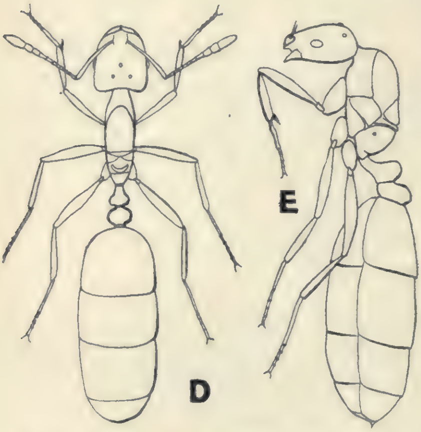
10. **Xenomyrmex stolli** *Forel* subsp. **floridanus** *Emery* var. **lucayanus** var. nov.

The worker of this variety differs in coloration both from the typical Guatemalan form and from the subsp. *floridanus*, while it agrees with the latter in its smaller size. It is pale yellow, with the thickened portions of the femora and the terminal antennal joint fuscous.

Two colonies of this ant were found on Andros Island; one in a Tillandsia on the north shore of the Southern Bight, the other in a hollow twig at Mangrove Key. The habits of the workers resemble those of *Monomorium floricola*, so far as could be ascertained by hasty observation in the field. According to Emery the types of *floridanus* were taken at Lake Worth, Florida, in a twig of the mastic tree (*Sideroxylon masticodendron*). The types of the species were taken with a species of *Camponotus* in a large oak-gall, and Forel concluded that the two forms were living in a state of xenobiosis. It is probable that this was accidental or merely a case of plesiobiosis, since the Floridian and Bahaman *Xenomyrmex* are known to live only in single colonies like most other Formicidæ.

11. **Monomorium floricola** *Jerdon.* — According to Emery this tropicopolitan species is, in all probability, a native of the East Indies. It seems to be rather rare on the eastern coast of Florida, where it has been taken by Mrs. Annie T. Slosson at Biscayne Bay and by myself on Key Largo. In the Bahamas it is very common, nesting by preference in the Tillandsias, but also in twigs and under the bark of living trees. I have specimens from the keys along the course of Crawl Creek, Western Andros, Mangrove Key, and from several places about Nassau, notably Fort Charlotte.

The males were found in nests on Key Largo, Florida, May 7, but were rare in the nests examined in the Bahamas. All the nests, however, contained numerous females, from five or six to thirty or more, and all of these females are ergatoid (Figs. D and E). At least I am unable to find anything in 108 specimens, which I have carefully examined, to indicate that they ever bear wings, although the thorax has the structure of the normal winged female in other species of *Monomorium*. As females of *floricola* from Barbados (Forel), Jamaica (Lyman Clark), and Havana, Cuba (C. F. Baker), all show exactly the same condition I am compelled to believe that it is perfectly normal. Though *M. floricola* is frequently mentioned in the literature to which I have access, nothing is said about the ergatoid character of the female, which occurs also in *M. carbonarium* subsp. *ebeninum* (*vide infra*), and the form which I have described as *M. minutum* Mayr subsp. *ergatogyna* from Santa Catalina Island, Cal. H. H. Smith, however, in his field notes on *floricola* in Forel's paper on the ants of St. Vincent (p. 389), mentions the occurrence of winged females taken December 14. Can it be that the species is double brooded and produces winged females during the winter and ergatoid forms during the summer months?



Monomorium floricola Jerdon, Ergatoid female. D, dorsal, E, lateral aspect.

While many species of *Monomorium* (*M. pharaonis*, the typical *M. minutum*, etc.) have normal winged females, some of the Oriental and African forms are said to have ergatoid females. Forel describes *M. andrei* of Oran as having both winged and ergatoid females (Bull. Soc. Vaud. Sc. Nat., Vol. XXX, No. 114, 1894, p. 20), and the same author mentions the occurrence of ergatoid females in the Indian *M. shurri* and *M. dichroum* (Rev. Suisse Zool., T. X, 1902, pp. 212, 213).

12. **Monomorium carbonarium** *F. Smith* subsp. **ebeninum** *Forel.*— Males, females, and workers from several nests found at Mangrove Key, Andros Island, and in and near Nassau, N. P. (Queen's Staircase and Hog Island). The males were taken May 31. In the Queen's

Staircase the nests were under stones; at Mangrove Key they were under stones and in the Tillandsias; on Hog Island they were found in the dry twigs of the buttonwood bushes. There were several females, sometimes as many as a dozen, in each nest, and, as in *M. floricola*, none of these showed any traces of ever having borne wings. The specimens are referred to *ebeninum* Forel on account of the decidedly angular epinotum in the worker. This subspecies has been recorded also from St. Thomas, Jamaica, and St. Vincent (Forel).

13. **Monomorium pharaonis** *Linn.* — This cosmopolitan house-ant could hardly be lacking in a seaport like Nassau. I found a few workers crossing the table-cloth in the cottage of the incomparable cook, Mrs. Becky McLaine.

14. **Monomorium salomonis** *Linn.* — Of this North African ant, which has not been recorded hitherto from the New World, I collected about forty specimens on the stone steps of a church in Nassau. The ants were leaving and returning to their nest in a crevice of the masonry. They were somewhat smaller and paler than a number of Algerian specimens sent me by my friend, Dr. Karl Escherich, but I am unable to detect any other differences.

15. **Cardiocondyla emeryi** *Forel.* — Workers of this interesting insect, which is known to occur in such diverse localities as Madagascar, Palestine, Madeira, and the West Indies, were found running over grassy and sandy soil in and near Nassau, N. P. It was common at Fort Charlotte, but the minute nests were not easily located. I failed to find the males and females. Certain species of *Cardiocondyla* are known to have ergatoid males, but this species has winged males, as Er. André and more recently Forel (Ann. Soc. Ent. Belg., T. XLVII, 1904, p. 422) have ascertained. It is possible, as the latter suggests, that the males of *Cardiocondyla* may be dimorphic, as in the case of *Ponera punctatissima* Roger and *P. eduardi* Forel. In these species Forel has found (*l. c.*, p. 421) both ergatoid and winged males.

16. **Solenopsis globularia** *F. Smith.* — A single colony taken May 14 at Nicholl's Town, Andros Island, in pure sand under a prostrate cocoanut trunk on the beach.

17. **Solenopsis geminata** *Fabr.* — No specimens of this common tropicopolitan species could be found on Andros Island or on any

of the adjacent keys, but a black variety, allied to the Texan var. *xyloni* McCook, was very common on New Providence Island wherever there was soil or sand (West Bay, Nassau, Hog Island, Stanley, etc.). It constructs straggling moundlets with many entrances, garners seeds, but still retains its carnivorous instincts, stings fiercely—in short, exhibits all the traits which have gained for it the name of 'hormiga brava' in Cuba and of 'fire ant' in many other localities.

18. **Pheidole androsana** sp. nov.

Soldier (Fig. F). — Length, 5.25 mm.

Allied to *Ph. guilelmi-muelleri* Forel. Head large, longer than broad, sides parallel, posterior corners rounded, separated by a deep occipital notch, which is continued forward as a deep frontal groove. Mandibles convex, with two very blunt apical teeth. Clypeus very short and flat, with a prominent median carina and slightly excised anterior border. Behind the frontal area, which is triangular, as long as broad, and fused with the clypeus, there is a rather deep elliptical pit. Antennæ short, their scapes bent at the base and dilated towards their tips, which reach only a short distance behind the eyes. Eyes convex, situated between the anterior and middle third of the head. Frontal carinæ large, flattened, continued back obliquely on either side as a ridge, which borders a shallow groove for the reception of the antennal scape. This ridge and groove end rather abruptly a little behind the middle of the head, and a little more than half way from the frontal groove to the lateral surface of the head. Pronotum with large rounded tubercles on the sides, without a distinct transverse depression and fold in front of the short and concave mesonotum. Epinotum with a longitudinal groove, its basal surface straight in profile, distinctly longer than the slightly concave declivity. Epinotal spines directed upwards, very short, not longer than broad at the base, hardly a third as long as the basal surface of the epinotum, and twice as far apart at their bases as they are long. Petiole from above nearly twice as long as broad, broadest through its posterior third; in profile the anterior slope of the medially excised node is long and slightly concave, the posterior slope shorter and convex. Postpetiole not quite three times as broad as the petiole, produced in the middle on either side to form a rather acute conule, which is directed slightly backward. Legs rather long.

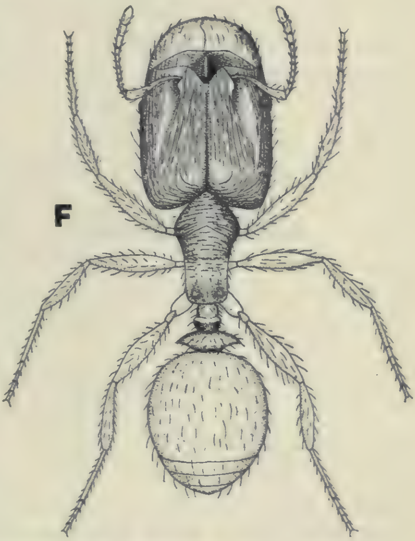
Mandibles smooth and shining, their discs with a few small punctures, and towards the edges of the blades with deeper parallel linear depressions. Clypeus in the middle smooth and shining, on the sides with coarse rugæ. Anterior four fifths of head with coarse longitudinal rugæ, which on the posterior fifth pass over into transverse rugæ of the same kind, so that the whole head is sculptured, but nevertheless somewhat shining. There is a faint tendency to anastomosis among the rugæ. Thorax somewhat shining like the head, tubercles glabrous; prothorax crossed transversely by coarse rugæ like those on the head; basal surface of epinotum rugose-punctate; declivity smooth but opaque; pleuræ with longitudinal and rather dense rugæ. Petiole and postpetiole nearly opaque, irregularly rugose-punctate. Gaster shining, the basal segment finely reticulate.

Hairs yellow, rather short and sparse, suberect on the antennal scapes and legs as well as on the upper surface of the body.

Deep reddish brown; mandibles red, broadly bordered with black; clypeus and anterior border of the head black, the former reddish in the middle; posterior edges of gastric segments yellowish; legs and antennæ light, clear yellow.

Worker. — Length, 2.5 mm.

Head somewhat longer than broad, sides subparallel, posterior corners rounded. Eyes near the middle of the lateral surfaces. Mandibles, 6–7-toothed. Clypeus short, with very broadly rounded, entire and depressed anterior border, convex behind in front of the triangular frontal area, and with a faint longitudinal carina. Antennæ like those of the soldier, but straighter, and extending for about one third of their length beyond the posterior corners of the head. Thorax rather long and slender; promesonotal region evenly convex in profile, without lateral tubercles; epinotum and spines as in the soldier. Petiole fully three times as long as broad, hardly wider behind than in front, with subparallel sides; node not excised in the middle, in profile much lower and more rounded than in the soldier. Postpetiole campanulate, about as long as broad. Legs rather long and slender.



Pheidole androsana **sp. nov. Soldier.**

Mandibles, clypeus, and frontal area shining, the first with sparse, piligerous punctures. Head and thorax subopaque, the former reticulate, with a few irregular longitudinal rugæ, especially on the front and cheeks; vertex rather smooth. Thorax with coarse, transverse rugæ, becoming longitudinal on the pleuræ, especially in the region of the epinotum. Petiole, postpetiole, and gaster smooth and shining.

Hairs yellow, erect, abundant, and rather long, conspicuous on the legs and antennal scapes as well as on the upper surface of the body.

Dark brown; postpetiole, gaster, and antennæ somewhat paler; legs yellow.

Described from one soldier and two workers taken on Fish Hawk Key at the west end of the Southern Bight, Andros Island.

The soldier of this species is related to *Ph. guilelmi-muelleri*, but differs in having pronounced transverse rugæ on the occiput, and in lacking the transverse groove and ridge on the pronotum. The thorax of the new species is also longer and more slender, and the hairs are much less abundant than in Forel's species. The worker is much darker and has very different sculpture. *Ph. androsana* seems also to be related to *Ph. breviconus* Mayr of Brazil, and still more closely to *Ph. cubaensis* Mayr. From the last species it differs in having the mandibles 2-toothed at the tip, and in having prominent transverse instead of irregularly reticulate rugæ on the occiput.

19. **Pheidole fallax** *Mayr* var. **jelskii** *Mayr.* — Males, females, soldiers, and workers were taken June 22–25 on New Providence Island (Queen's Staircase, Fort Charlotte, etc.) and on an adjacent key, Hog Island. In the female the wings, which were wanting in the specimen described by Forel (Trans. Ent. Soc. London, 1893, p. 400), are grayish with yellow veins and stigma. This species is carnivorous. Its nests are flat moundlets, about four inches in diameter, built in sandy, grassy places. The soldiers have the rank odor so characteristic of the ants belonging to the genus *Eciton.*

20. **Pheidole megacephala** *Fabr.* — This common tropicopolitan species is recorded from the "Bahamas" by Emery (Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 294) without more specific locality. I did not find it on Andros or New Providence.

21. **Pheidole subarmata** *Mayr* var. **nassavensis** var. nov.

Several soldiers and workers, taken in and about Nassau, N. P. (Queen's Staircase, Fort Charlotte, etc.), from small nests in grassy places and occasionally under stones, differ in their paler coloration from Costa Rica specimens received from Prof. Emery. The soldier is yellow, with the mandibles and anterior half or two thirds of the head red, the pronotum and gaster somewhat infuscated. The hairs on the tibiæ are suberect and prominent. The worker is yellow, with the upper surface of the gaster slightly infuscated.

22. **Pheidole flavens** *Roger.* — Numerous soldiers, workers, males and two females, which I refer to the typical Cuban form of this variable species. The soldier has between the cephalic striæ none of the punctures which are faintly visible in the var. *vincentensis* Forel. The Bahaman specimens resemble the var. *thomensis* Emery from St. Thomas in cephalic sculpture, but their color is much paler, as I find by comparing them with a cotype received from Prof. Emery. The females agree with Roger's description of the type in coloration, the males with Forel's description of the male of *vincentensis.* My specimens were taken from several colonies found under stones and in and under old palmetto logs on Andros (Nicholl's Town and Crawl

Creek) and on New Providence (Nassau, Fort Charlotte, West Bay) Islands.

23. **Pheidole punctatissima** *Mayr* subsp. **annectens** subsp. nov.

Soldier. — Similar in color to *Ph. anastasii* Emery of Costa Rica, but differing in the shape of the postpetiole, which is broader and has more acute lateral conules in the Bahaman form, as I find by comparing it with a type of *anastasii* received from Prof. Emery. In *annectens* the conules are in the middle and not in front of the middle of the segment, as in the subsp. *insulana* described below. Head, thorax, and pedicel reddish yellow; mandibular teeth, clypeus, and anterior margin of head black; antennæ and legs yellow. Hairs on the body long and abundant, suberect; rather short and inconspicuous on the legs and antennæ.

Worker. — Much darker in color than the worker of *anastasii:* head and thorax dark brown, gaster paler; antennæ and legs yellow.

Female (deälated). — Postclypeal portion of head opaque, with the longitudinal rugæ extending back nearly to the occiput. Pronotum very finely rugose and subopaque, the rugæ being somewhat concentric about a point in the middle line near the anterior edge. Paraptera subopaque, finely striated. Scutellum smooth and shining, sparsely and coarsely punctate, transversely rugose behind. Epinotum opaque on the sides and very coarsely and longitudinally rugose; between the spines densely punctate. Spines robust, acute, about as long as they are broad at the base. Node of petiole high, compressed, and transverse; produced on either side in the middle to form a rather blunt conule. Its upper surface is transversely rugose. Whole of first gastric and posterior edges of succeeding segments opaque, very finely punctate. Head, thorax, and petiole ferruginous red; gaster dark brown, with the anterior and posterior corners of the first segment and the posterior edges of all the segments reddish yellow; antennæ and legs pale yellow. Hairs covering the body and legs moderately long and abundant, suberect.

Several small colonies of this subspecies were found under stones and palmetto logs at Mangrove Key on the eastern coast of Andros Island.

24. **Pheidole punctatissima** *Mayr* subsp. **insulana** subsp. nov.

Soldier. — Agrees with Mayr's description of *Ph. punctatissima* except in coloration and the shape of the postpetiole. Body dark brown; mandibles red, with black teeth; clypeus, anterior third of head, antennæ, legs, and petiole yellow. Extreme posterior portion of head smooth and shining. Epinotal spines directed upwards and very slightly backwards. Postpetiole on either side produced into an acute conule, which is distinctly in front of the middle of the segment. According to Mayr's description, the postpetiole of *punctatissima* has more obtuse lateral angles. Hairs on head, gaster, and legs long, suberect.

Worker. — Resembles the worker of the preceding species in color.

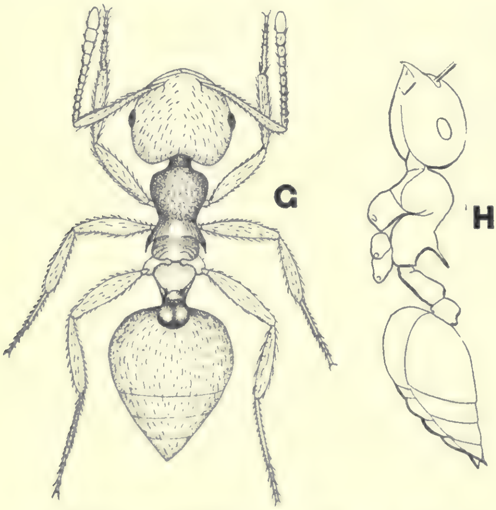
Workers and soldiers from several colonies were found in rotten palmetto boles or under stones in vegetable mould on the keys about the west end of the Southern Bight, Andros Island, and near the Blue Hills, New Providence Island.

25. **Cremastogaster ashmeadi** *Mayr.* — Two workers, nearly black in color, with dark red antennal funiculi and tarsi, were taken on a key in Crawl Creek, western Andros. They may represent a distinct variety, but this cannot be determined without more material. The typical form is common on the eastern coast of Florida (Miami and Card's Point) and the adjacent keys (Key Largo, etc.), where it may be found attending aphides and Coccidæ on the mangroves and other trees.

26. **Cremastogaster lucayana** sp. nov.

Worker (Figs. G and H). — Length, 2.7–4 mm.

Allied to *C. lineolata* Say. Antennal scape surpassing by fully twice its greatest diameter the posterior angle of the head; club 3-jointed. Clypeus distinctly flattened in front. Frontal area rather indistinct, triangular, narrower than long. At the posterior end of the slender frontal groove there is a very distinct dimple or impression. Thorax strongly constricted in the mesoëpinotal region. Epinotal spines straight or but very slightly recurved at their tips, strongly diverging outward, upward, and backward, shorter than the distance between their bases. Petiole from above about as long as broad, in profile distinctly narrower dorsoventrally in front than behind. Postpetiole narrower than the petiole, with a deep median groove. Gaster broad, triangular, flattened above.



Cremastogaster lucayana sp. nov. Worker; G, dorsal; H, lateral aspect.

Mandibles, clypeus, cheeks, and front finely but sharply and longitudinally striated, opaque; vertex somewhat smoother and more shining, with distinct transverse rugæ in the occipital region. Thorax opaque; pro- and mesonotum and base of epinotum very coarsely and vermiculately rugose, the rugæ being more longitudinal on the base of the epinotum and on the pleuræ. Epinotal declivity, petiole, postpetiole, and gaster smooth and shining.

Hairs whitish, rather inconspicuous, mostly appressed on the body and legs, suberect on the antennal scapes, longer and more prominent on the clypeus, front and upper surfaces of the thorax and gaster.

Head and thorax piceous brown, posterior portion of head, antennæ, and legs darker; gaster black; in some specimens the basal portions of the gastric segments are more brownish or piceous.

Female (deälated). — Length, 6.8 mm.

Head sculptured like that of the worker, except the posterior portion, which is sparsely punctate. Upper portion of the thorax subopaque, more sparsely punctate than the back of the head. Meso- and metapleuræ sharply and longitudinally rugose. Pilosity like that of the worker. Head, thorax, petiole, postpetiole, and legs dark reddish brown, mesonotum with a yellowish **U**-shaped blotch on its disc; scutellum and gaster black.

Many workers and a single female, collected on Fish Hawk Key and other keys along the course of the Southern Bight in western Andros, and near the Blue Hills in New Providence. In all of these localities the species was common in grass and sedge culms and in the Tillandsias growing on the bushes along the edges of the 'swashes.'

C. lucayana is closely allied to *C. sanguinea* Roger of Cuba in having the petiole lower in front than behind. It resembles *C. vermiculata* Emery of California in sculpturing, but has strongly diverging epinotal spines and longer antennal scapes. Its odor is quite unlike that of *C. lineolata*, of which it can hardly be regarded as a mere subspecies.

27. **Cremastogaster lucayana** subsp. **etiolata** subsp. nov.

Worker. — Length 3–4 mm.

Differing from the preceding form in sculpture, pilosity, and coloration. Mandibles and cheeks indistinctly striate, the former sparsely punctate. Body smooth and shining, especially the posterior portion of the head and the gaster. Thorax subopaque; pronotum rather coarsely and longitudinally rugosepunctate in front, smoother behind; basal surface of epinotum with numerous longitudinal rugæ, declivity smooth and shining.

Hairs white, rather sparse, mostly appressed, longer and suberect on the clypeus, mandibles, front, upper portions of thorax, and gaster. The hairs on the antennal scapes and legs are appressed and inconspicuous.

Yellow; in most specimens the gaster is black with the exception of the posterior border of the first segment; in others all except the two or three terminal segments are yellow, with a black band across their posterior edge. Mandibles reddish with black teeth.

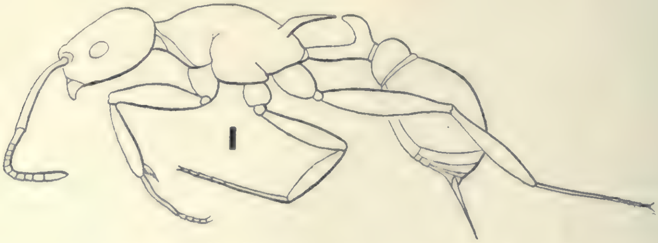
Female. — Length 7 mm.

Resembling the worker in color and pilosity. Head finely and sparsely punctate. Pronotum very smooth and shinging; epinotal spines short, conical, far apart, and directed backward. Body, legs, and antennæ reddish yellow;

mandibles and antennal funiculi darker. Thorax and epinotum clouded with brown. Each gastric segment is crossed near its posterior edge by a dark band, which is narrow in the middle and as broad as the segment on either side where it surrounds a deep yellow spot. Venter yellow in the middle. Wings whitish hyaline, with brownish yellow veins and stigma.

Described from one female and many workers taken May 18 and 23 on the keys along the northern shore of the Southern Bight, Andros Island. One of the nests was in a dead branch of a gum mastic tree, the others in Tillandsias on mangroves at the edge of the 'swashes.'

28. **Cremastogaster victima** *F. Smith* var. **steinheili** *Forel.*—Numerous colonies containing males and winged females were found nesting in hollow twigs, and especially in the Tillandsias growing on the mangroves and other shrubs in the 'swashes' of Andros. These colonies were particularly abundant on Big Wood Key (May 16), Pot Key, and other keys along the course of the Southern Bight (May 18 and 19). A few specimens were also taken at West Bay on New Providence Island. All the specimens collected represent a form assignable to the var. *steinheili*, although the females are considerably larger (6–7 mm.) than a female type (4.6 mm.) of *steinheili* from Kingston, Jamaica (Forel), in my collection.



Macromischa pastinifera Emery var. *opacipes* var. nov. Worker.

29. **Macromischa pastinifera** *Emery* var. **opacipes** var. nov.

Two workers (Fig. I), found running over the ground under some dead palmetto leaves on a key in Crawl Creek, western Andros, agree with Emery's description and figure of the type from the "Bahama Islands," except in having the legs entirely opaque and finely punctate, instead of shining. On this account the specimens may be regarded as representing a distinct variety.

30. **Macromischa lucayensis** *Forel.* — This species, described by Forel from a single winged female from the "Bahama Islands," is

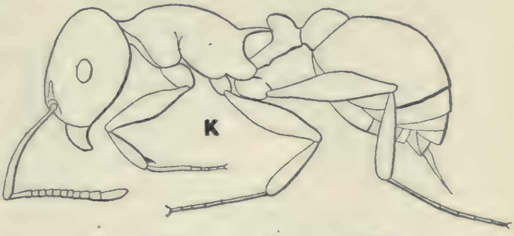
apparently very closely related to the preceding species and to *M. androsana* (*vide infra*), but the femora are not incrassated.

31. **Macromischa androsana** sp. nov.

Worker (Fig. K). — Length 1.9–2 mm.

Head, excluding the mandibles, somewhat longer than broad, with broadly rounded posterior angles and straight occipital border. Eyes in the middle of the sides of the head. Mandibles 5-toothed. Clypeus with straight, hardly excised anterior border. Antennæ 12-jointed, scape reaching to the posterior corner of the head; funiculus with a distinct 3-jointed club, joints 2–7 broader than long; 8th joint as broad as long; terminal joint longer than the two preceding subequal joints of the club. Thorax in profile with rounded dorsum, without a mesoëpinotal constriction, twice as long as high; seen from above it is a little wider in front than behind, its sides are sub-parallel; including the neck it is more than twice as long as broad. Epinotal spines long, directed backward, curved downward and outward, more than twice as long as the distance between their bases. Petiole with a long peduncle, toothed below in front; node very high, arising abruptly from the peduncle, so that its anterior surface runs obliquely downward and backward from the summit, which is rounded and passes over rapidly into the convex posterior declivity. Seen from above the node has a semicircular anterior and nearly straight posterior outline. Postpetiole twice as broad as the petiolar node and twice as broad as long, rounded in front, and not constricted at its union with the gaster; in profile campanulate and very convex dorsally. First gastric segment with a straight anterior border. Sting very long and powerful. Legs, especially the hind pair, very long; tibiæ, and especially the femora, incrassated.

Body and appendages opaque with the exception of the gaster, which is very glabrous, and the frontal area and upper surface of the post-petiole, which are slightly shining. Antennæ and legs subopaque. Mandibles finely and densely striated and rather coarsely punctate. Clypeus and frontal area longitudinally rugose. Head densely and evenly punctate, with more scattered, somewhat larger and shallower punctures interrupting the uniformity of the surface. Thorax, petiole, and postpetiole finely and uniformly punctate, the pronotum and pleuræ also with some irregular and not very prominent rugæ. Legs and antennal scapes very finely and evenly punctate or granular.



Macromischa androsana sp. nov. Worker.

Hairs snow-white, obtuse, and erect on the upper surface of the head, thorax, pedicel, and gaster; minute and appressed on the antennæ and legs.

Black, thorax and petiole yellowish red; mandibles, anterior border of clypeus, frontal carinæ, antennæ, and legs dark brown. In some specimens the femora are black. Tarsi and sting more yellowish.

Described from nine workers found in two localities on Crawl Creek, Andros Island. The ants were running about under dead leaves that had fallen from the palmettos. I failed to locate their nests.

M. androsana is related to *M. pastinifera*, but is readily distinguished by its much shorter antennæ. The antennal scapes of *pastinifera* extend far beyond the posterior corners of the head, all the joints of the funiculus are decidedly longer than broad, the club is less distinct, and its last joint is not longer than the two preceding joints. The clypeus is distinctly notched, the petiolar node is higher, more concave in front, and the hind legs are longer. The head is red like the thorax and not black, the thorax is more rounded in profile, etc. *M. lucayensis* Forel can hardly be the female of *androsana*, on account of its red head and non-incrassated femora.

32. **Macromischa splendens** sp. nov.

Worker (Pl. VII, Fig. 9). — Length 3–3.5 mm.

Head, excluding the mandibles, distinctly longer than broad, sides subparallel, posterior corners broadly rounded, posterior border straight. Eyes prominent, in the middle of the sides of the head. Mandibles 5-toothed. Anterior border of clypeus very faintly excised in the middle. Antennæ 12-jointed; scape reaching to the posterior corner of the head; funiculus with a distinct 3-jointed club, the last joint of which is longer than the two preceding subequal joints; joints 2–8 somewhat broader than long. Thorax without a mesoëpinotal suture or constriction, but slightly arched above, its dorsal surface somewhat flattened, in profile fully three times as long as high; seen from above it is a little wider in front than behind, with rounded humeral angles and subparallel sides. Epinotal spines shorter than the concave declivity of the epinotum, about twice as long as the distance between their bases, directed outward, upward, and backward, their tips slightly curved downward. Petiole with a slender peduncle, bluntly toothed on its ventral surface; node abrupt and prominent, evenly rounded in profile. Postpetiole campanulate, half again as broad as the petiole. Gaster small, with a very long and powerful sting. Legs long, especially the hind pair, with much thickened femora and tibiæ. Hind metatarsus as long as the tibia.

Body shining; petiole, postpetiole, gaster, and legs shining. Mandibles very coarsely rugose-punctate. Clypeus and whole head longitudinally rugose, the rugæ of the latter being somewhat vermiculate. Thoracic dorsum crossed by a regular series of deep, curved furrows, which are continued back even over the declivity of the epinotum and obliquely forward and downward on the pleuræ, so that there is no interruption in the sculpture of the thorax except on the neck, which is much more finely and transversely reticulate-rugose. Legs finely reticulate, covered with very coarse piligerous punctures.

Body and appendages clothed throughout with abundant, erect, long, slender, silvery white hairs.

Head and thorax deep metallic green, passing on the cheeks, pleuræ, and epinotum into metallic violet. Mandibles, clypeus, frontal carinæ, neck, terminal tarsal joints, sting, and anterior end of petiolar peduncle dull orange; remainder of petiole, postpetiole, gaster and legs deep black; coxæ, trochanters, and extreme bases of femora honey-yellow.

Female (deälated.) — Length 4–4.5 mm.

Resembling the worker. The epinotal spines are much shorter, more rapidly tapering, and further apart at their bases than long. The pronotum is transversely and irregularly rugose, the mesonotum and paraptera are evenly and longitudinally rugose; the scutellum has three systems of rugæ, one oblique on either side and meeting in the middle, and one consisting of a few transverse rugæ in the middle near the posterior edge of the sclerite. Epinotum transversely furrowed like the whole thorax of the worker. On the pleuræ the rugæ are longitudinal. The legs have the same structure as in the worker. In color the following differences can be detected: A broad band across the middle of the head is metallic bronze, or golden, and the petiole and postpetiole have a slightly metallic violet tinge. The venter and bases of the gastric segments, except the first, are yellowish brown.

Male. — Length 3–3.5 mm.

Head, excluding the mandibles, longer than broad, much broader behind than in front. Cheeks long, subparallel. Eyes prominent, in the middle of the sides of the head. Posterior corners of the head rounded, posterior border convex. Mandibles large, 6-toothed. Clypeus convex, faintly emarginate in the middle. Antennæ 13-jointed, very slender; scape nearly as long as the funiculus, and extending about one third its length beyond the posterior corner of the head; funiculus with an indistinct 4-jointed club, the last joint of which is nearly as long as the three preceding joints; remaining funicular joints somewhat longer than broad, first joint conspicuously thickened. Thorax with very deep Mayrian furrows and a very deep promesonotal constriction, so that the front of the mesonotum rises abruptly. Scutellum with a prominent median keel. Epinotum very small, distinctly angular in profile, but quite unarmed. Petiole very long and slender, the peduncle, which has no tooth on its ventral surface, passing in profile gradually into the very low node; in dorsal view the petiole widens gradually toward its posterior end, which is about one fourth as broad as the length of the segment. Postpetiole about half again as broad as the petiole, campanulate, as long as broad. Gaster rather short, compressed dorsoventrally, genitalia prominent and exserted in some of the specimens. Legs long and slender, femora and tibiæ hardly incrassated. Wings with a very prominent stigma, with a single cubital and no discal cell.

Mandibles and clypeus coarsely punctate, the latter also coarsely and longitudinally rugose. Head and thorax subopaque, densely reticulate-rugose, the rugæ being longitudinal on the head, mesonotum, and scutellum, and transverse on the pronotum; mesopleuræ rather smooth and shining. Petiole, postpetiole, gaster, and legs glabrous.

Hairs white and erect on the body, antennæ, and legs, but less conspicuous than in the worker.

Black, the head and thorax with an indistinct metallic greenish lustre in some specimens. Mandibles, clypeus, cheeks, front, and sides of pronotum, wing-insertions, metapleuræ, coxæ, and trochanters dull orange or brownish. Genitalia and terminal tarsal joints pale yellow. Wings whitish hyaline; veins colorless, stigma yellowish.

Four colonies of this superb species were found, June 25, nesting in hollow culms of *Cladium jamaicense*, in marshy ground along the road that leads from Grant's Town to the Blue Hills near Nassau, N. P. There were only 50–75 ants in a colony. They were timid, and moved about rather slowly, with the gaster bent forward between the long hind legs. The nest entrance was a small round hole in one of the internodes of the sedge culm, which was filled with the translucent larvæ and pupæ.

M. splendens belongs to the group of beautiful Cuban species (*M. purpurata*, *porphyritis*, *squamifera*, *versicolor*, and *iris*), described many years ago by Roger, but not since seen by myrmecologists. The new species seems to be most closely related to *M. squamifera*, but, according to Roger's description, this species has the head rugose only in front of the eyes, the postpetiole is not broader than the petiole, the node of the latter is strongly compressed anteroposteriorly, and the hind metatarsus is shorter than the tibia.

33. **Rogeria curvipubens** *Emery.* — A couple of workers found running on the rocky soil near Mangrove Key, Andros, agree very closely with Emery's description of this species.

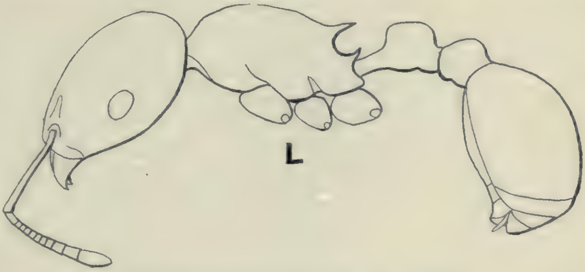
34. **Tetramorium guineense** *Fabr.* — This tropicopolitan species seems to be a rather recent importation into the Bahamas. I failed to find it on New Providence, and on Andros only a few specimens of it were seen in two localities: on Fish Hawk Key on the western, and Mangrove Key on the eastern coast of the island.

35. **Tetramorium lucayanum** sp. nov.

Worker (Fig. L). — Length 2.25–2.5 mm.

Head quadrangular, excluding the mandibles somewhat longer than broad. Mandibles broad, 5-toothed. Anterior border of clypeus transverse, without teeth. Each frontal carina is continued back as a prominent ruga which, especially behind, bounds a distinct elongate elliptical scrobe for the reception of the antennal scape. Antennæ 12-jointed, scape not reaching the posterior corner of the head. Thorax seen from above with prominent humeral angles, in profile with faint but distinct mesoepinotal depression, especially in the pleural region. Epinotal spines rather slender, straight, directed outward, upward, and backward, somewhat longer than the distance between their bases. Episterna produced into prominent spines, fully half as long as those on the epinotum, pointed and curved upward at the tips. Petiole distinctly pedunculate, the node in profile quadrangular, rising abruptly in front, with a horizontal dorsal surface and steep posterior declivity; seen from above it is oval, somewhat narrower in front than behind, and about 1½ times as long as broad. Postpetiole subglobular, about as long as broad, distinctly broader than the petiole. Gaster rather small. Legs robust, with thickened, fusiform femora.

Body shining throughout. Mandibles rather delicately striato-punctate. Clypeus with several longitudinal rugæ. Head and thorax traversed by sharp longitudinal rugæ which are not very close together and have a tendency to become reticulate, especially on the thorax; interrugal spaces with shallow punctures which are much finer and denser on the antennal scrobes. Node of petiole with very coarse reticulate rugæ, several of which are conspicuously transverse. Postpetiole smooth except for a few longitudinal wrinkles on the sides. Gaster glabrous.



Tetramorium lucayanum sp. nov. Worker.

Hairs pale yellowish, sparse, long, and erect on the body, much shorter, more numerous, and appressed on the antennæ and legs.

Black; mandibles, antennæ, legs, and tip of gaster reddish yellow; neck, peduncle of petiole, scapes, and femora dark brown.

Described from two workers found running on the ground in the Queen's Staircase at Nassau, N. P.

This species seems to be sufficiently distinct from other American species of *Tetramorium*, like *T. balzani* Emery from Paraguay, and *T. reitteri* Mayr of Brazil. In sculpture it resembles the former species, to judge from Emery's description.

36. **Tetramorium simillimum** *Nylander.* — This tropicopolitan species is common in certain localities near settlements both on Andros and New Providence. At Nicholl's Town, on the eastern coast of the former island, I found it in and under rotting cocoanut boles that had been prostrated some years ago by a hurricane. These nests contained many males and winged females (May 14). On New Providence the species was common under stones in the Queen's Staircase in Nassau, in the Menendez Sisal Plantation near Stanley, and in the dwindling 'pine yards' near the Blue Hills.

37. **Cryptocerus varians** *F. Smith.*

Soldier (Pl. VII, Figs. 1, 2 and 3). — Length 5–6 mm.

Head surmounted by an elliptical dish-shaped disk, 1½ times as long as broad, with a median anterior fissure extending back a little over ⅙ of its length. The floor of the disk is raised in the middle just behind the fissure and again less prominently farther back; the edge is nearly or quite smooth in front but distinctly and somewhat irregularly crenellated behind. The disk completely conceals the head with the exception of its crenated and somewhat upturned posterior corners, between which the occiput is concave. Thorax nearly 1½ times as long as broad and nearly 1½ times as broad in front as behind. Pronotum with prominent and rather acute angles, and a high ridge, interrupted in the middle, across its posterior portion. Sides of epinotum with two broad, indistinct teeth in front of the prominent posterior angle. Petiole and postpetiole of equal breadth, or the latter but very little broader than the former, each produced laterally into a rather blunt or even slightly truncated tooth, that of the petiole being nearer the middle of the segment and somewhat smaller than the postpetiolar tooth. Gaster elongate elliptical, 1¾ times as long as broad, anteriorly marginate on the sides, with a deep, curved excision for the accommodation of the pedicel. Legs short and robust.

Subopaque, upper surface of cephalic disk shining, especially in front. Head, thorax, and petiole covered with circular foveolæ which are larger and more scattered on the head, especially on its anterior portion, much denser and somewhat smaller on the thorax and pedicel. Sides and declivity of epinotum finely and evenly granular. On the petiole and postpetiole the foveolæ are so close together that these segments appear coarsely reticulate-rugose. Gaster finely and evenly granular, with scattered punctures which are larger and denser and more like the thoracic foveolæ on the base and almost absent at the posterior end of the enlarged first segment. Legs very finely and evenly granular and covered with small shallow punctures.

Hairs very short, silvery white, scale-like, appressed, each in the centre of one of the foveolæ. Cephalic disk fringed with somewhat longer, erect, clavate hairs, and there are similar hairs on the tip of the venter.

Black or brownish black; gaster, legs, and antennæ deep reddish brown. Young callow specimens are yellow, somewhat older ones rich ferruginous red throughout.

Worker (Pl. VII, Fig. 4). — Length 3–4.25 mm.

Head a little narrower in front than behind, its posterior border nearly straight, with blunt posterior angles; eye in a deep rounded excision just in front of the posterior corner. Anterior corners rounded, in front separated by a deeply rounded median excision which permits the small mandibles to be seen from above. Thorax more than 1½ times as long as broad, somewhat broader in front than behind, sharply marginate on either side. Promesonotal suture obsolete, mesoepinotal suture straight; the anterior corners of the mesonotum marked by a distinct tooth. Pronotum with distinct humeral angles and the epinotum with a distinct tooth on the side near its base. Petiole and postpetiole of equal breadth, each with a prominent tooth on either side, obliquely truncated at the tip. Gaster elliptical, flattened, roundly excised in the middle anteriorly, with a much flattened margin along its basal third. Legs short and robust.

Whole body subopaque, finely granular, covered with rather dense foveolæ, which are smaller and less circular than in the soldier. Sculpture of gaster and legs as in the soldier.

Pilosity like that of the soldier, except that there are no clavate hairs on the head.

Deep ferruginous brown, almost black; gaster, cephalic lobes, legs, and antennæ reddish. Callow specimens are much paler, even yellow when first hatched.

Female (Pl. VII, Fig. 5). — Length 6.5–7.5 mm.

Resembling the soldier. The cephalic disk, though of the same shape, is distinctly smaller and has a shorter anterior incision; it is shallower and has only one somewhat larger convexity in its floor. The edge of the disk is irregularly crenellated throughout. Humeral and epinotal angles of the thorax short, stout, and acute. Petiole and postpetiole subequal, 1½ times as broad as long, slightly angular in front, but rounded on the sides. Gaster oblong, about three times as long as broad, its sides parallel, its anterior border broadly and roundly excised; there is no compressed lateral margin. Legs short. Wings long, reaching fully one mm. beyond the tip of the gaster.

Sculpture like that of the soldier, except that the foveolæ on the cephalic disk are even larger and more uniformly distributed, as large, in fact, as the ocelli. The disk is subopaque like the remainder of the body.

Pilosity like that of the soldier, but there are almost no hairs on the foveolæ of the head, and those on the thorax and gaster are inconspicuous.

Color like that of the soldier. Wings decidedly infuscated, veins and stigma dark brown.

Male (Pl. VII, Fig. 6). — Length 4–4.5 mm.

Head broader behind than in front, decidedly broader than long; cheeks concave, eyes and ocelli very prominent; mandibles well developed, dentate; clypeus short and broad, its anterior border straight. Frontal area large, triangular, impressed. Frontal groove pronounced, extending from the frontal area to the anterior ocellus. Antennæ long, 13-jointed, joints 3–13 subequal in length, but increasing very gradually in thickness towards the tip. First joint thick, hardly half the length of the third, second joint very small, not incrassated, not longer than broad. Thorax with deep Mayrian furrows. Scutellum flattened. Epinotum somewhat rounded in profile, its basal and declivous surfaces of about equal length. Petiole and postpetiole subequal, seen from above about as long as broad, angular in front, with straight sides slightly converging behind. In profile the petiole is somewhat more convex than the postpetiole. Gaster slender, first segment occupying a little over half its length, the remaining segments subequal. Genitalia exserted. Legs rather short.

Mandibles, head, thorax, and pedicel opaque, finely granular, or punctate. Occipital portion of the head sparsely foveolate and somewhat reticulate-rugose. Dorsal and pleural surfaces of thorax finely and obscurely longitudinally striated, most clearly on the scutellum, metanotum, and basal epinotal surfaces. Gaster and legs smooth and shining.

Hairs yellow, longest and suberect on the head, thorax, and gaster; very short and appressed on the antennæ and legs.

Head, thorax, and pedicel black; base of mandibles, antennæ, coxæ, and gaster dark brown. Tips of mandibles, palpi, legs, posterior edges of gastric segments, and genitalia pale yellow. Wings whitish hyaline with yellow veins and conspicuous brown stigma.

This species was found on Andros, but not on New Providence. It was rather common on the keys along the course of the Southern Bight (Pot Key, Fish Hawk Key, etc.) and Crawl Creek, at Mangrove Key, and Little Golding Key. It lives in hollow twigs, in the culms of *Uniola* and *Cladium*, and in Tillandsias. In twigs and culms the nest entrance is elliptical, with its long axis parallel with the long axis of the stem, and just the size of the head of the soldier. The very same species was found at Card's Point, Florida, nesting in Tillandsias of the same species as those found on Andros. In habits *C. varians* thus closely resembles *C. aztecus* Forel and *C. wheeleri* Forel, which I have observed in Mexico. The winged females and males were taken at Card's Point, May 30, and on Little Golding Key, June 19.

C. varians is closely related to *C. pallens* (= *C. discocephalus* F. Smith and *C. araneolus* F. Smith), as Emery has surmised (Bull. Soc. Ent. Ital., An. 28, 1896, p. 76), and may even be regarded as a subspecies of that form. The petiole and postpetiole of the worker and soldier of *varians*, however, are narrower and of a different shape, and the thorax of the soldier is not so broad behind. I have figured all four phases of this species, as the soldier, male, and female have not been seen hitherto.

38. **Strumigenys lanuginosa** sp. nov.

Worker. — Length 2.25 mm.

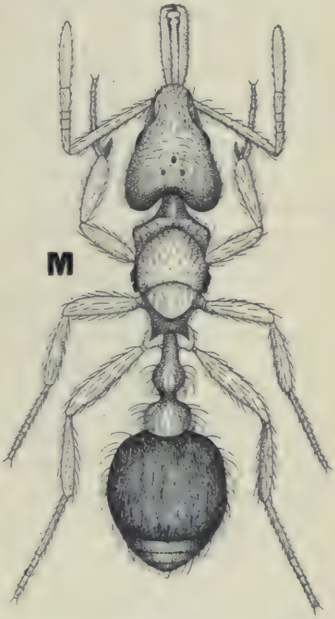
Head much narrowed in front, broadened behind, with deeply and roundly excised posterior margin and rounded posterior angles. Eyes in the middle of the sides of the head where there are also well-developed scrobes for the accommodation of the antennal scapes. Mandibles straight, linear, with parallel inner and outer borders, a little over half as long as the head, with two prominent teeth bent in at right angles at the tip, and a short but distinct tooth on the inner border just behind the tip. Clypeus triangular, equilateral, its posterior border straight, not extending over the base of the mandibles. Antennal scape about half as long as the head exclusive of the mandibles, slender at the base, but rapidly enlarging towards the tip, where it again narrows. Terminal funicular joint as long as the four basal joints taken together; first and fourth joints subequal, each somewhat longer than the second and third joints taken together. Thorax with distinct mesoëpinotal constriction. Pronotum flattened, with sharp humeral angles, distinctly marginate in front and along the sides, and longitudinally carinate on the middle of its posterior half. Epinotum armed with two acute spines which are somewhat longer than broad at their bases, further apart than long, directed backward and slightly outward, and produced below as very small membranous laminæ. Both the petiole and postpetiole with prominent spongiform appendages on their posterior and inferior surfaces; postpetiole half again as broad as the petiole; nodes of both semicircular from above, straight in front and convex behind; in profile the anterior slope of the petiolar node is gradual and concave. First gastric segment with spongiform appendages on its anterior and inferior border.

Mandibles smooth, subopaque. Head, thorax, petiole, and postpetiole opaque, densely punctate; thoracic dorsum somewhat rugulose. Gaster smooth and shining, first segment above opaque, with very fine longitudinal striæ.

Body and appendages covered with long, delicate, flexuous, yellowish hairs, which are largely reclinate or appressed on the head, thorax, and legs, but sub-erect, very conspicuous, and abundant on the gaster. There are no club-shaped or obtuse hairs, and the curved hairs on the anterior border of the antennal scapes are inconspicuous.

Ferruginous brown; petiole, postpetiole, and gaster darker; mandibles, antennæ, and legs more yellow. Mandibular teeth black.

M



Strumigenys lanuginosa sp. nov. Female (deälated).

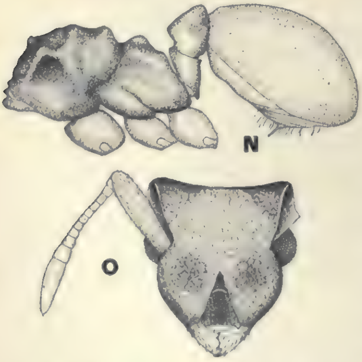
Female (deälated). (Fig. M). — Length 2.5–2.8 mm.

Resembling the worker very closely, except in the structure of the thorax. The basal surface of the epinotum is long, oblique, and distinctly concave. The inferior membranous laminæ of the epinotal spines is more extensive. The spongiform appendages on the petiole, postpetiole, and basal gastric segment are very conspicuous. Color and pilosity as in the worker; alar insertions black.

Described from a single worker and five females taken in and about Nassau (in the Queen's Staircase and the moat around Fort Charlotte). The females were in the act of founding their colonies. Each was found under a stone covering a nest of *Tetramorium simillimum*, *Pheidole flavens*, or *Monomorium ebeninum*. This fact suggests that the new species, like several other species of the genus *Strumigenys*, habitually forms compound nests with other ants.

S. lanuginosa is closely related to *S. unidentata* Mayr, *unispinulosa* Emery, *imitator* F. Smith, *louisianæ* Roger, and *fusca* Emery. It differs from the first in having perfectly straight mandibles, from the second in having the head much narrower in front, spongiform appendages on the petiole, no clavate or squamiform hairs, etc.; from the third in having a distinct tooth on the inner border of the mandibles just behind the two apical teeth; from the fourth in having the preapical mandibular spine shorter, and in lacking the club-shaped and scale-like hairs on the body; from the last in its smaller size, in having a shorter preäpical spine, the head narrower in front, spongiform appendages on the petiole, etc.

39. **Cyphomyrmex rimosus** *Spinola* subsp. **minutus** *Mayr* (Figs. N and O). — No form of *C. rimosus* was found on Andros Island, but numerous workers from several nests collected near Nassau, N. P., (Fort Charlotte, Menendez Sisal Plantation, and Blue Hills), agree with Emery's description of the subsp. *minutus* (Bull. Soc. Ent. Ital., XXVIII, 1896, pp. 89, 90). The nests were under stones, where the ants were guarding their fungus gardens on caterpillar excrement. The fungus consisted of small translucent, pear-shaped, yellow bodies, about .5 mm. in diameter. They were of exactly the same size and appearance as those which I first saw in the fungus gardens of the subsp. *dentatus* Forel in Mexico. More recently I have found these gardens and fungi in the nests of a dark variety of *rimosus* at New Braunfels, Texas, and in the nests of another variety on Key Largo, Florida. There can be no doubt that previous authors have been mistaken in asserting that this species does not cultivate fungi like all the other known species of Attii. The fungi have simply been overlooked because they are not in the form of a white mycelium. I have kept the Texan variety in artificial nests, and have seen the workers carefully raising and eagerly eating the bodies which must belong to some hitherto undescribed fungus very different from the *Rhozites gongylophora* Moeller.



Cyphomyrmex rimosus Spinola subsp. *minutus* Mayr. Worker. N, body in profile; O, head from the front.

40. **Atta (Trachymyrmex) maritima** sp. nov.

Worker (Pl. VII, Figs. 7 and 8). — Length 4.5–5.5 mm.

Head, excluding the mandibles, as long as broad, deeply and angularly excised behind, with rather convex sides. Eyes large, flattened, a little in front of the middle of the head. Mandibles large, with 7–8 subequal, acute teeth. Clypeus sinuately excised in the middle of its somewhat flattened anterior border. Antennal scape extending between a fourth and a third of its length beyond the posterior corner of the head. Frontal carina dilated anteriorly to form a flat, rounded lobe over the antennal insertion, and continued back to the posterior corners of the head. Lateral carina running just inside the eye, forming the outer boundary of the antennal scrobe, and continued to the posterior corner of the head, where it ends in a prominent blunt spine. The frontal carina does not reach this spine, so that the two carinæ are separate near their ends, the frontal terminating in a more indistinct spine of its own. The vertex has two median spines, and there is also a very prominent occipital spine on either side and still another smaller one further forward between the occipital and the eye. The two prominent spines on the posterior angle of the head are of the same size and shape. Thorax long and slender, much narrower than the head. Pronotum on either side with a long, blunt spine, but no median spines or tubercles between these on the anterior border of the segment. The inferior pronotal spine is long and blunt and directed downwards. The promesonotal are nearly as long as the superior pronotal spines, but broader at the base and more robust. They are blunt at the tip. Behind these are two pairs of much smaller spines, the posterior pair being very short. Epinotal spines long, slender, and acute. Petiole with a short peduncle in front, enlarging rapidly behind to form a node which is suboblong when seen from above, in profile acute above, with a straight ascending anterior slope and a more abrupt, slightly concave posterior declivity. The node is armed with four equidistant teeth. Postpetiole more than twice as broad as the petiole, as long as broad, its upper surface behind with a large subtriangular concavity. Gaster pyriform, distinctly longer than broad, broader behind than in front, its dorsal surface with three large longitudinal depressions extending over its basal half. Legs, especially the hind pair, long and slender.

Mandibles shining, punctate; toward their bases opaque and striate. Body, antennæ, and legs opaque and uniformly granular, covered with small but very distinct tubercles, which occur also on the spines and large tubercles. On the base of the gaster these small tubercles are less abundant on the three longitudinal depressions and more closely aggregated on the ridges separating and bounding them. The small tubercles are absent also on the concave dorsal surface of the postpetiole.

Hairs short, curved, or hooked, black in some lights, yellowish in others, arising from the small tubercles only. Pubescence restricted to the funiculi of the antennæ.

Head and gaster black or very dark brown. Thorax, petiole, postpetiole, mandibles, antennæ, and legs varying from yellow to deep ferruginous brown; the concave portions of the thorax and pedicel more or less spotted with black or dark brown. Tibiæ and antennal scapes darker in color than the femora and funiculi. Teeth and outer borders of the mandibles black.

This species is common on both Andros and New Providence Islands. On the former it was seen wherever I landed and searched for it —at Big Wood Key, Mangrove Key, and on several of the uncharted keys along the course of the Southern Bight and about Crawl Creek. In New Providence I found it only near Fort Charlotte. It prefers to nest in the pure foraminiferous sand of the seashore at or just above high-water mark. Its nests, which are inconspicuous and are most readily found by tracking foraging workers, are surmounted by a very flat moundlet 1–1½ ft. across, with a single somewhat excentric entrance ⅓–¼ in. in diameter. This opening leads down into a chamber about as large as an egg some 8 in. below the surface, and this is apparently connected at a lower level with other similar chambers, which, however, are reached through crevices in the Æolian limestone, and cannot be excavated with the trowel. In one of the superficial chambers I unearthed a poorly developed fungus garden, closely resembling that of *A.* (*T.*) *septentrionalis* McCook. Like this species *A.* (*T.*) *maritima* collects buds, small flowers, bits of dead and living leaves, and caterpillar excrement as a substratum for its gardens. When rudely touched the workers fall over and 'feign death.' There are hardly more than 150 ants in a colony. At first I was inclined to believe that the species must be restricted to the sea beaches, but on walking inland about two miles from All Saints' Rectory at Mangrove Key, I found it nesting also in the clearings among the 'coppets,' wherever a small amount of soil in the cavities of the rough limestone has induced the negroes to plant maize, etc. Here the ants were busily engaged in cutting and collecting bits of green maize leaf, after the manner of the species of *Atta sensu stricto*. In other places, like Fort Charlotte, N. P., the ants were nesting in the dry, shady 'coppets,' but here, too, they inhabit inaccessible nests in the ubiquitous limestone.

A. (*T.*) *maritima* is very closely related to three other West Indian species of the subgenus *Trachymyrmex: urichii* Forel of Trinidad, *jamaicensis* E. André of Jamaica, and *smithii* of St. Vincent. It differs from the first and second in lacking the pair of prominent tubercles on the middle of the pronotum, from *urichii* also in its larger size, much longer scapes, and darker color. It is very closely related to *smithii*, and may prove to be merely a subspecies of this form, which I know only from Forel's description. *A. smithii* is described as more robust than *saussurei* Forel, but *maritima* is certainly more slender and graceful than this species. In *maritima* the frontal and lateral carinæ do not unite in a single tubercle on the posterior angle of the head. The gaster, too, seems to be of a different shape. Forel describes two sets of smaller tubercles on the surface of his species: "de petits tubercules, densément repandus partout et gros comme les mailles d'une ponctuation réticulaire médiocrement fine, de gros tubercules plus espacés qui couvrent le corps et les pattes comme de mouchetures." This description certainly does not apply to *maritima*, which has only a single system of tubercles, apparently intermediate in size between the two systems occurring in *A. smithii.*

Subfamily DOLICHODERINÆ.

41. **Tapinoma litorale** sp. nov.

Worker. — Length 1.25–1.5 mm.

Head, excluding the mandibles, a little longer than broad, as broad behind as in front, with convex cheeks and straight posterior border. Eyes small, with about 6–7 ommatidia in the longitudinal diameter, flattened, in front of the middle of the head. Mandibles multidenticulate along their entire inner edges, the teeth on the basal portion of the blade being very minute, but gradually increasing in length to the apex. Clypeus broadly rounded in front, slightly sinuate in the middle of the anterior border. Antennal scapes not reaching the posterior angles of the head; first funicular joint as long as the two succeeding joints, second joint broader than long; joints 3–10 subequal, hardly longer than broad, terminal as long as the three preceding joints, constricted at its base, so that it seems to form a one-jointed club. Thorax of the usual shape. Petiole with flattened upper surface, without a node. Basal segment of gaster concealing the petiole. Anus large and terminal.

Subopaque throughout, the surface of the body microscopically reticulate; mandibles feebly punctate.

Body, antennæ, and legs uniformly covered with very fine white pubescence. There are a few inconspicuous white hairs on the gaster, clypeus, and mandibles but none on the thorax.

Pale yellow; upper surface of body brownish in some specimens, which have also the posterior edges of the gastric segments broadly yellow. Eyes and mandibular teeth black.

Female (deälated). — Length 3–3.5 mm.

Head distinctly narrowed in front. Antennal scape reaching to the posterior corner of the head; terminal joint less distinctly separated from the rest of the funiculus than in the worker. Gaster long and narrow.

Sculpture, pilosity, and pubescence as in the worker, except that the hairs at the tip of the gaster are more numerous.

Head and thorax yellow, with their dorsal surfaces dark brown. Gaster dark brown, posterior edges of segments broadly yellow. Antennæ, mouthparts, legs, and petiole yellow. Mandibular teeth and eyes black.

Male. — Length 1.3–1.5 mm.

Head large, excluding the mandibles and including the very large prominent eyes, as broad as long. Cheeks very short; postocular borders straight, converging behind, posterior border straight. Ocelli large and protruding. Mandibles hardly as long as the eyes, acute, with finely and obscurely denticulate blades. Clypeus short, with straight anterior border. Antennal scape long, reaching to the posterior corner of the head, funicular joints subequal, distinctly longer than broad, terminal joint about 1½ times as long as the preceding. Thorax rather small, thickset; mesonotum not arched above, hardly as broad as the head. Epinotum sloping, faintly angular in profile. Gaster with large, exserted genitalia, the outer appendages of which are broadly rounded. Wings with one cubital and no discal cell.

Surface of body much more shining than in the worker, microscopically reticulate.

Hairs almost completely absent; pubescence much more dilute than in the worker.

Pale yellow; upper surface of head, thorax, and gaster brownish; antennæ slightly infuscated, inner borders of mandibles black.

This species, which is sufficiently distinct from all the species of *Tapinoma* of which I have seen descriptions, was very common at Card's Point, Florida, along the Southern Bight, Andros Island, at West Bay, and about Nassau, N. P. (Fort Charlotte, Blue Hills, Hog Key, etc.). In all of these localities it was found nesting along the 'swashes' and beaches between the leaves of Tillandsias, in the hollow culms of *Uniola* and *Cladium*, or in the twigs of trees and bushes. It thus resembles in habits *T. ramulorum* Emery from Costa Rica. The nest entrance in the culms consisted of a little perforated papilla of gray vegetable paste made by the ants. This papilla projected slightly from the outer surface of the culm, and was often continued a short distance into the cavity inhabited by the insects. Males were found in all the nests opened during May and June. At Card's Point the species seemed to have a predilection for forming double nests with other ants; at any rate I found several colonies living in the same Tillandsias with colonies of *Cryptocerus varians*, *Pseudomyrma elongata*, or *Camponotus planatus*. These double nests were in all respects similar to those which I have described from Mexico as cases of parabiosis.

42. **Tapinoma melanocephalum** *Fabr.* — Three colonies of this tropicopolitan species were found in rotten wood near All Saints' Rectory, Andros Island.

43. **Tapinoma pruinosum** *Roger.* — Workers from a single colony found on Fish Hawk Key at the western end of the Southern Bight, Andros Island. Somewhat larger specimens were also taken at Planter on Key Largo, off the coast of Florida. Emery has recorded this

species from the "Bahamas" (Zool. Jahrb., Abth. f. Syst., Bd. 8, 1894, p. 333).

44. **Dorymyrmex pyramicus** *Roger* var. **niger** *Pergande.* — The only form of this common neotropical species which I have seen in the Bahamas. It is black, with a rather low epinotal cone. It occurs abundantly in the sand of the seashore above high-water mark on Andros (Dog Key, Nicholl's Town, Mangrove Key, etc.), and at West Bay on New Providence Island.

Subfamily CAMPONOTINÆ.

45. **Brachymyrmex heeri** *Forel.* — A single colony, including several winged females, of the typical form of this species, was found under a stone on a key in the Southern Bight, Andros Island, May 23.

46. **Brachymyrmex heeri** *Forel* var. **obscurior** *Forel.* — Very common in shady places under stones and logs in all the localities in which I collected on Andros and New Providence Islands. During May and June the nests contained numerous males and winged females.

47 **Brachymyrmex minutus** *Forel* — A small colony comprising several workers and two deälated females, which agree very closely with Forel's description of this species, was found at Nicholl's Town, Andros Island, under a stone in the shade of a 'coppet.'

48. **Prenolepis guatemalensis** *Forel* subsp. **antillana** *Forel.* — This form is common and widely distributed on Andros and New Providence. It nests under stones and logs in rather moist places. Males and winged females were found during May and June. The workers are somewhat larger and darker in color than a type from St. Vincent given me by Prof. Forel, but the genital valves of the male have the same form. It is very probable, as Forel suggests, that both the typical *guatemalensis* and its subspecies, *antillana*, should be regarded as subspecies of *P. fulva* Mayr.

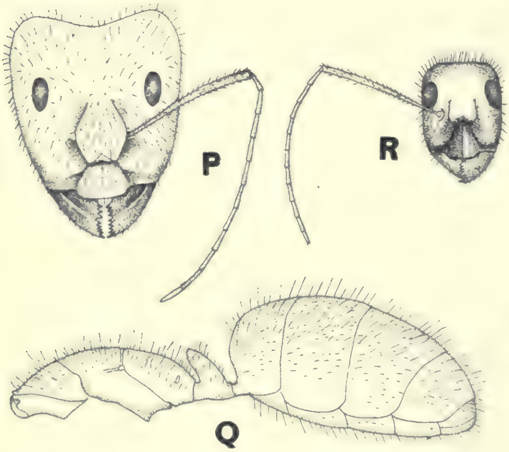
49. **Prenolepis longicornis** *Latr.* — This tropicopolitan species, which is common in New Providence (Nassau and environs), but very sporadic on the eastern coast of Andros (Big Wood Key, Mangrove Key), where it seems to be of recent importation, occurs in houses and is known as the 'crazy ant' on account of its singular erratic movements. Winged females were taken from a nest in an old cocoanut shell on the beach of Big Wood Key, May 16.

50. **Prenolepis** sp. — A few workers of a small, black, thickset species of *Prenolepis*, from a key in the Southern Bight, Andros Island, represent some form which is certainly not *steinheili* Forel or any described subspecies of *fulva* or *guatemalensis*. As I have no males I refrain from describing the specimens as a new species.

51. **Camponotus maculatus** *Fabr.* subsp. **lucayanus** subsp. nov.

Worker major (Figs. P and Q). — Length 10–12 mm.

Head large, narrowed in front, posterior corners prominent, occipital border concave. Clypeus rather indistinctly keeled, its anterior lobe broad, with rounded corners and straight median border. Mandibles 8–9-toothed. Antennal scapes slender, not compressed at the base. Thorax narrow, pronotum about half as broad as the head; in profile much lower than in forms like subsp. *maccooki*, *vicinus*, etc.; evenly rounded; epinotum very flat, barely angular, basal surface nearly twice as long as the declivity. Hind femora without bristles on their flexor surfaces.



Camponotus maculatus Fabr. subsp. *lucayanus* subsp. nov. P, head of worker major; Q, same from side; R, head of worker minor.

Mandibles glabrous, coarsely punctate. Head, thorax, and gaster subopaque, shagreened. Clypeus and cheeks with coarse and rather shallow elongate punctures or foveolæ; remainder of the head more opaque, with smaller scattered punctures, except between the frontal carinæ, where they are of the same size as on the cheeks. Antennal scapes punctate. Thorax and gaster somewhat shining.

Hairs abundant, yellow, erect, conspicuous on the cheeks, posterior portions of the head, front, antennal scapes, legs, thorax, petiole, and gaster. Pubescence on the prothorax and gaster yellow, long, sparse, and appressed; shorter and much denser on the antennal funiculi.

Ferruginous red. Mandibles, antennal scapes, upper surface of head and thorax, darker; gaster dark brown, almost black, with yellow posterior edges to the segments. Legs reddish yellow, tarsi and funiculi somewhat darker. Mandibular teeth, anterior border of clypeus, anterior corners of head, a cloud on the front, and external to each antennal insertion, black. In some specimens the whole thoracic dorsum is ferruginous red.

Worker media. — Length 7–9 mm.

Closely resembling the soldier except in the smaller size of the head, which is only $1\frac{1}{2}$ times as broad as the prothorax, and in smaller specimens is hardly broader behind than in front.

Worker minor (Fig. R). — Length 6–7.5 mm.

Head slender; including the mandibles, twice as long as broad, cheeks very straight and parallel, with prominent anterior angles. Clypeus broadly rounded in front, rather convex, and distinctly keeled. Thorax slender, in profile very low and flattened; basal surface of epinotum straight, almost concave, fully three times as long as the declivity, with which it forms a very obtuse angle.

Somewhat shining, body more coarsely, legs very finely, shagreened; mandibles punctate.

Erect hairs much less abundant than in the worker major, dense and short on the antennal scapes, but conspicuous on the cheeks, clypeus, dorsal surface of head, thorax, petiole, and gaster. Pubescence long and sparse on the head, prothorax, and gaster.

Reddish yellow, upper surface of head darker; gaster dark brown, with broadly yellow segmental incisures. Mandibular teeth black.

Female. — Length 11–12 mm.

Resembling the worker major. Epinotum with convex, rounded basal surface and flattened declivity. Petiole broad, compressed anteroposteriorly, with blunt dorsal edge; seen from behind the node is straight and transverse above, with rounded corners and slightly convex sides converging below.

Sculpture, pilosity, and color as in the worker major, but head more uniformly dark ferruginous above. Clouds on the mesonotum, scutellum, and metanotum brown. There is a black spot in front of the insertion of the fore wing. Wings pale yellowish hyaline, with yellow veins and stigma.

Described from specimens from some ten colonies collected both on Andros (Little Golding Key, Crawl Creek, Fish Hawk Key, and other keys along the course of the Southern Bight; Nicholl's Town) and New Providence (Menendez Sisal Plantation, Hog Key). The colonies nest in and under old palmetto logs and stumps. The winged females were taken in one of the colonies on Crawl Creek, May 22.

At first glance *C. lucayanus* is readily confounded with *C. abdominalis* subsp. *floridanus* Emery, on account of its bright ferruginous red color and conspicuous pilosity, but closer examination shows that it belongs to the *maculatus* group and is allied to the subsp. *tortuganus* Emery. This form, however, has no erect hairs on the cheeks and antennal scapes, and all the major workers I have seen—including a number which I have taken from large colonies containing males and winged females at Miami, Florida—have much smaller heads than the major workers of *C. lucayanus*. Through the var. *tephronotus* it passes over into forms like the subsp. *picipes* and its var. *pilosula* Forel of Mexico. *C. maculatus* subsp. *soulouquei* Forel seems also to be an allied form, but the worker major has opaque mandibles and a much less sloping epinotum according to Forel's description.

52. **Camponotus maculatus** *Fabr.* subsp. **lucayanus** var. **tephronotus** var. nov.

Workers major, media, and minor.—Head, thorax, and dorsal portion of petiole very dark brown, almost black; in other respects like the typical *lucayanus*.

Female. — Mandibles red, with black teeth. Upper surface of head, mesonotum, scutellum, metanotum, mesopleuræ, and basal surface of epinotum black. Pronotum clouded with brown and bordered with black behind. In other respects like the female of the typical *lucayanus*.

Male. — Length 7 mm.

Head small. Cheeks long, concave. Eyes and ocelli very large. Mandibles spatulate, blunt, and toothless. Thorax robust; mesonotum high, swollen, 1⅓ times as broad as the head; epinotum convex, evenly rounded. Petiole low, with a blunt, medially notched node. Genitalia very large and exserted, much more voluminous than in the larger males of *maccooki*, *vicinus*, *tortuganus*, etc.

Body subopaque, finely shagreened; clypeus, front, and cheeks finely punctate.

Hairs abundant, yellow, erect; longest on the head, both upper and lower surfaces, and gaster; scapes with suberect hairs. Pubescence very sparse and inconspicuous.

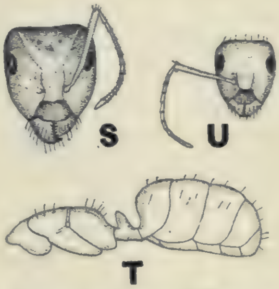
Yellow; upper surface of head, mesonotum, scutellum, epinotum, and mesopleuræ brown. Gaster dark brown, posterior margins of segments, genitalia, legs, and antennæ yellow. Wings suffused with yellow throughout, with yellow veins and stigma.

This variety was taken in only two localities: on High Key, a small island off the eastern coast of Andros, and in the 'pineyard' near Blue Hills, New Providence. In the former locality it was very common under stones among which the terns were nesting. Here I took the winged females, June 2. The colony found near Blue Hills was also nesting under a large stone and contained both males and winged females (June 27). The females in this colony had a median brown band, widest anteriorly, running the full length of the mesonotum.

53. **Camponotus inæqualis** *Roger* var. **ramulorum** var. nov.

Worker major (Figs. S and T). — Length 6–7.5 mm.

Belonging to the *maculatus* group. Head about as long as broad, subtriangular, much narrower in front than behind, sides rounded, posterior border straight. Mandibles with seven teeth, which gradually increase in length towards the apex. Clypeus sharply carinate, produced into a broad lobe in front which is rounded on the sides and very faintly sinuate in the middle. Eyes large, flat, broadly elliptical, behind the middle of the head. Vertex with three small impressions simulating ocelli. Antennæ rather robust, scape not compressed at the base, enlarging towards the tip, which surpasses by a little more than its transverse diameter the posterior corner of the head. Thorax rather robust, prothorax three fifths as broad as the head, meso- and meta-thorax laterally compressed; in profile the thorax is rather high, evenly arched as far back as the beginning of the epinotal declivity, which forms a very blunt angle with the basal epinotal surface and is of about the same length. Petiole convex in front and flattened behind, with a rather sharp border which is hardly excised in the middle. Gaster and legs of the usual shape.



Camponotus inæqualis Roger var. *ramulorum* var. nov. S, head of worker major; T, body of same from side; U, head of worker minor.

Body shining, very finely shagreened. Mandibles, clypeus, and anterior two thirds of the head sparsely punctate.

Hairs yellow, very sparse, erect, absent on the legs and antennæ, except at the tips of the scapes and femora. Each gastric segment has a single row of hairs along its posterior edge.

Yellow; mandibles reddish brown with black teeth. Head dark brown or black, especially on its upper surface, posterior corners yellow; the black portion extending back beyond the vertex in the form of a blunt point. Pronotum in the middle with a large dark brown or black triangular spot, broadest behind, sides with dark brown clouds; meso- and epinotum and pleuræ spotted with black or brown. Gaster with a broad dark brown band across each segment; on the second and third segments this band suddenly narrows on either side. Petiole and legs yellow; tarsi and antennæ reddish.

Worker minor (Fig. U). — Length 5–6 mm.

Head, excluding the mandibles, $1\frac{1}{2}$ times as long as broad, with slightly rounded sides, not narrower in front than behind; posterior margin straight. Mandibles 6-toothed. Clypeus and eyes like those of the worker major. Antennal scape projecting about $\frac{1}{3}$ its length beyond the posterior corner of the head. Thorax very similar to that of the worker major; in front somewhat narrower than the head. Petiole narrower, more obtuse, and seen from behind with a more convex border than in the worker major.

Sculpture and pilosity as in the worker major. The head and thorax in some specimens are uniformly yellow or have only a few pale brown clouds on their dorsal surfaces. The brown bands on the gaster are paler and narrower than in the worker major.

Female. — Length 12–13 mm.

Resembling the worker major. The head is narrower and the antennal scapes project somewhat further beyond the posterior corners. Epinotum rounded, with short basal and abrupt and longer declivity. Node of petiole broad, rather blunt, with a transverse, faintly sinuate upper border.

Sculpture and pilosity as in the worker major. Mesonotum with a few piligerous punctures. Hairs on the thorax somewhat more abundant.

Sides of head more yellow than in the worker major. The mesonotum has a median, triangular, dark brown patch, broadest in front, and a dark cloud on either side. Scutellum and basal surface of epinotum dark brown; mesopleuræ clouded with brown. Bands on the gastric segments very broad, especially in the middle. Wings yellowish hyaline, with yellow veins and brown stigma.

Male. — Length 5–6 mm.

Head, including eyes and excluding mandibles, as long as broad, evenly rounded behind, narrower through the cheeks which are long and distinctly concave. Mandibles with a feeble tooth behind the apical tooth. Clypeus evenly rounded in front, convex and bluntly carinate in the middle. Antennæ very long, slender. Thorax robust, mesonotum projecting upward and forward; epinotum convex, faintly angular in profile. Petiole low and thick, with a very blunt node. Genitalia small and very slender. Legs long.

Smooth and rather shining, very finely shagreened, the head somewhat more distinctly than the thorax.

Dark brown; edges of sclerites, intersegmental constrictions of gaster, mandibles, funiculi, and genitalia yellow or sordid. Wings as in the female.

This form, which I do not hesitate to refer to Roger's *C. inæqualis* of Cuba, is far and away the most abundant species of the genus on Andros and New Providence Islands. It is nocturnal and forms small colonies like those of our *C. marginatus*, in the hollow twigs of trees or bushes and between the leaves of Tillandsias along the 'swashes' and 'coppets.' Specimens from many colonies were collected in the following localities: Blue Hills, Fort Charlotte, and Hog Key near Nassau, N. P., and on all the keys that were visited along the Southern Bight and about Crawl Creek in western Andros. Some specimens collected by Prof. C. H. Eigenmann near Havana, Cuba, in a dried bean-pod, belong to this same variety, which differs from the form described by Roger and the following variety in the large amount of black or dark brown on the head and thorax.

54. **Camponotus inæqualis** *Roger* var. **marcidus** var. nov.

All four phases differ from the corresponding forms of var. *ramulorum* in having much less brown or black on the head and thorax. In some colonies the worker major has the anterior third of the head dark brown, with a large yellow spot on the middle of the clypeus and a large brown blotch on the vertex. In others nearly the whole head is immaculate. The thorax of the worker major commonly has a conspicuous brown blotch on the mesopleuræ, and another smaller one on the side of the pronotum. The female has only faint brownish clouds on the head and thorax. The males are yellow, with brown vertex, scutellum, and gaster, the intersegmental constrictions of which are broadly yellow.

This form, which is also common in hollow twigs and Tilliandsias, occurs in various localities in Andros (Dog Key, along the Southern Bight, Big Wood Key, Mangrove Key, Little Golding Key). It approaches the typical form of the species very closely, but may stand as a variety till it is possible to study specimens of the form described by Roger.

55. **Camponotus landolti** *Forel* subsp. **zonatus** *Emery* var. **eburneus** var. nov.

Workers major and minor and female closely resembling the corresponding phases of *zonatus* specimens in the collection of the American Museum of Natural History from Olinda, Brazil, and Grenada, Nicaragua, except in the coloration of the gaster. In the worker minor the third and fourth gastric segments each have two large ivory-yellow spots, which are closely approximated but do not fuse in the middle; the corresponding spots on the first and second segments are united medially, the former by a broad, the latter by a very narrow band. In the worker major and the female the spots on the second segment remain disconnected. The female measures 11 mm.

Workers from a single colony found under a stone at Fort Charlotte near Nassau, and a solitary deälated female taken from a hollow twig on Hog Key, N. P.

56. **Camponotus** (**Colobopsis**) **culmicola** sp. nov.

Soldier (Pl. VII, Fig. 10). — Length 5.3–6.5 mm.

Very closely related to *Colobopsis impressus* Roger and *C. pylartes* Wheeler. Head subcylindrical, rectangular from above, a little longer than broad, sides parallel, occipital border straight, with rounded angles; anterior truncated surface concave with distinctly carinate edge on the sides, but rounded in the clypeal and adjacent regions. Mandibles with a convex ventral border, four teeth, and a short toothless proximal portion to the blade. Clypeus on the truncated surface nearly twice as long as broad, broadest above, extending on to the dorsal surface of the head as a transversely oblong piece twice as long as broad. A median carina runs the full length of the clypeus. Frontal carinæ far apart, distinctly converging anteriorly, slightly convex exteriorly. Eyes moderate, flattened, their anterior orbits about $\frac{1}{3}$ the distance from the posterior corner of the head to the tip of the mandibles. Antennal scapes slender, curved at the base, enlarging towards their tips which exceed the posterior corners of the head by a distance about equal to their transverse diameter. Funicular joints subequal, except the first, which is nearly as long as the two succeeding joints together. Thorax more robust than that of *C. pylartes*, but less robust than that of *C. impressus*. Pronotum as long as broad, mesonotum nearly as long as broad. Mesoëpinotal constriction deep and long; basal epinotal surface slightly convex, a little longer than the flattened declivity with which it forms almost a rounded right angle. Petiole very low, with a subcuboidal node, distinctly impressed in the middle above and behind. Gaster large, oblong elliptical, somewhat flattened dorsoventrally. Legs short, femora compressed, anterior pair distinctly dilated.

Mandibles opaque, finely punctate and obscurely reticulate-rugose. Anterior half of head subopaque, coarsely and rather regularly reticulate-rugose, the interrugal spaces being densely punctate. On the front and cheeks the sculpture passes over into shallow, umbilicately punctate foveolæ. Behind this region the surface for a short distance is very finely and densely punctate. Remainder of head and body shining, very finely but distinctly shagreened; meso- and epinotum subopaque.

Cheeks and anterior dorsal surface of head with short, erect, obtuse yellowish hairs. There are also a few erect white hairs on the vertex, tips of antennal scapes and femora, and on the gastric segments.

Dark brown, posterior two thirds of head darker, gaster and mandibular teeth black; remainder of mandibles and anterior third of head yellowish brown.

Worker (Pl. VII, Fig. 11). — Length 4–4.5 mm.

Head a little longer than broad, slightly broader behind than in front, cheeks convex. Mandibles 5-toothed, when closed having their outer borders more projecting than in the worker of *C. impressus*. Clypeus nearly square, obscurely keeled. Frontal carinæ converging in front. Antennæ more slender and proportionally longer than in the soldier, extending about $\frac{1}{3}$ their length beyond the posterior corners of the head. Thorax and petiole resembling the corresponding parts of the soldier. Gaster proportionally smaller and more pointed.

Body and appendages subopaque, gaster and posterior portion of head shining; whole surface shagreened, more sharply on the head and thorax, so that these parts have a silky lustre. Cheeks and front with indistinct, scattered punctures.

Hairs and pubescence white, very sparse; the former confined to the head and gaster, the latter most conspicuous on the cheeks and legs.

Dark brown, antennæ somewhat paler in some specimens; gaster black, immaculate.

Female. — Length 6.5–7 mm.

Head like that of the soldier but more elongate and without carinate edges to the truncated portion in the region of the cheeks. Antennal scapes projecting about twice as far beyond the posterior corners of the head.

Sculpture and pilosity as in the soldier.

Dark brown; gaster black; anterior fourth of the head yellowish; articulations of the thorax and legs whitish; first, second, and third gastric segments yellow at the base; the lighter color confined to the extreme base of the first segment, broad and conspicuous on the second, and on the third very narrow and often concealed, except at the sides, by the posterior edge of the second segment; ventral surfaces of the first and second segments more or less yellow. Wings whitish hyaline, with very pale yellow veins and stigma.

Male. — Length 4–4.5 mm.

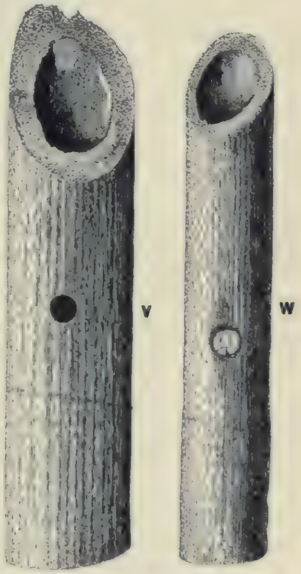
Head, including the mandibles, a little longer than broad, with prominent eyes and ocelli; cheeks slightly converging anteriorly, posterior corners broadly rounded. Mandibles pointed, toothless, overlapping when closed. Clypeus sharply keeled. Antennæ slender; scape more than half as long as the funiculus, which is filiform and consists of subequal joints, with the exception of the conspicuously incrassated first joint. Thorax robust; mesonotum longer than broad, forming a regular ellipse with the scutellum. Epinotum steep, evenly rounded, so that basal and declivous surfaces are indistinguishable. Petiole very low, longer than high, thick and blunt above, somewhat impressed in the middle. Legs and gaster slender, the latter with slender genital appendages.

Shining throughout, finely shagreened, especially on the head and thorax.

Hairs whitish, much scattered, suberect, confined to the head and gaster. Pubescence lacking except on the antennal scapes.

Dark brown; head nearly black; mandibles, genitalia, articulation of the antennæ, legs, thorax, and gaster sordid yellow. Wings like those of the female.

Many specimens of all four phases from the keys along the course of the Southern Bight, Andros Island, and near Blue Hills, N. P. The colonies were all found nesting in the hollow culms of *Cladium jamaicense* along the damp edges of the 'swashes.' The internode of the culm is perforated by the ants with a circular opening, which is exactly occluded by the head of the soldier guarding the nest (Figs. *V* and *W*). Sometimes the nests extend over several internodes of the same stem, and in such cases there may be two or more circular openings guarded by as many soldiers. One deälated female was found in the act of starting her colony. Males and winged females were abundant in the nests taken in the Southern Bight, May 23, but were absent or rare in the colonies taken in New Providence as late as June 25.



Pieces of culms of a sedge (*Cladium jamaicense*) inhabited by colonies of *Camponotus* (*Colobopsis*) *culmicola* sp. nov. V, shows circular nest entrance; W, the opening closed by the stopper-shaped head of a soldier.

It is doubtful whether *C. culmicola* should be regarded as more than a subspecies of *C. impressus* of Florida. The soldier of the new form is larger, and has a less convex and thickset thorax, but the other differences may be unimportant. *C. culmicola* differs from *C. pylartes* of Texas in not having inflated cheeks or yellow bands on the gaster in the soldier and worker, though these bands are present in the female. It would be permissible to regard *pylartes* also as a subspecies of *impressus*.

A LIST OF THE KNOWN WEST INDIAN FORMICIDÆ.

Subfamily PONERINÆ.

1. **Prionopelta punctulata** *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 367–369. ☿ ♂.

2. **Paraponera clavata** *Fabr.*

Antilles.—*Dalla Torre*, Catalog. Hymenopt., VII, Formicidæ, 1893, p. 18.

3. **Emeryella schmitti** *Forel.*

Hayti.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 334, 335. ☿.

4. **Ectatomma quadridens** *Fabr.*

St. Thomas (?).—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, Jahrg., 1862, p. 732.

5. **Ectatomma (Holcoponera) concentricum** *Mayr.*

Jamaica.—*Er. André*, Rev. d'Entomol., 1893, p. 152.

6. **Platythyrea punctata** *F. Smith.*

San Domingo.—*F. Smith*, Cat. Hymenopt. Ins. Brit. Mus., Pt. 6, Formicidæ, 1858, p. 108. ☿ ♂.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 358, 359. ☿ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿.
Barbados, Jamaica, Guadeloupe.—*Forel*, Rev. Suisse Zool., XI, F. 3, 1901, pp. 335, 336.
New Providence.—*Wheeler, antea*, p. 81. ☿ ♀.
Cuba.—*Wheeler, antea*, p. 81. ☿.

7. **Platythyrea angusta** *Forel.*

Antilles of Trinidad.—*Forel*, Rev. Suisse Zool., IX, F. 3, 1901, pp. 336, 337. ☿

8. **Pachycondyla (Pseudoponera) stigma** *Fabr.*

Andros.—*Wheeler, antea*, p. 81. ☿ ♀ ♂.
New Providence.—*Wheeler, antea*, p. 81. ☿ ♀.

9. **Pachycondyla (Pseudoponera) stigma** var. **attrita** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 362, 363. ☿ ♀ ♂.

10. **Neoponera villosa** *F. Smith.*

Puerto Rico.—One worker in collection of Am. Mus. Nat. Hist. (C. T. Brues.)

11. **Ponera ergatandria** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 365–367. ☿ ♀ ♂.
Andros.—*Wheeler, antea*, p. 82. ☿.

12. **Ponera fœda** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 364, 365. ☿ ♀.

13. **Ponera opaciceps** *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 363. ☿.
New Providence.—*Wheeler, antea*, p. 82. ☿ ♀.

14. **Ponera succedanea** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 170. ☿ ♀ ♂.

15. **Ponera trigona** *Mayr.* var. **opacior** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 363, 364. ☿ ♀.

16. **Leptogenys arcuata** *Roger.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 359, 360. ☿ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ♂.

17. **Leptogenys falcata** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., V, 1861, p. 42, No. 123. ☿. *Ibid.*, VI, 1862, p. 244, Taf. 1, fig. 14. ☿ ♂.

18. **Leptogenys mucronata** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 360, 361. ☿.

19. **Leptogenys pubiceps** *Emery.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 361, 362. ☿ ♂.
Martinique.—One ☿ from Ft. de France, received from Prof. Forel (Coll. Am. Mus. Nat. Hist.).

20. **Leptogenys pubiceps** *Emery* var. **vincentensis** *Forel.*

St. Vincent.—*Forel*, Rev. Suisse Zool., IX, F. 3, 1901, p. 328. ☿.

21. **Leptogenys unistimulosa** *Roger*, var. **trinidadensis** *Forel.*

Trinidad.—*Forel*, Rev. Suisse Zool., IX, F. 3, 1901, p. 328. ☿.

22. **Anochetus mayri** *Emery.*

St. Thomas.—*Emery*, Ann. Mus. Civ. Genova, XXI, 1884, p. 378, No. 1. ☿; Ann. Soc. Ent. France, (6) X, 1890, p. 65. ☿ ♀.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 356. ☿ ♀.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿.
Martinique.—One ☿ received from Prof. Forel (Coll. Am. Mus. Nat. Hist.).

23. **Anochetus (Stenomyrmex) inermis** *Er. André.*

Trinidad.—*Er. André*, Rev. d'Entomol., VIII, 1889, p. 221. ☿.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿ ♂.

24. **Anochetus (Stenomyrmex) emarginatus** *Fabr.* subsp. **testaceus** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 356–358. ☿ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿.
New Providence.—*Wheeler, antea*, p. 82. ☿.

25. **Odontomachus hæmatodes** *Linn.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 353, 354. ☿ ♀.
Jamaica.—*Er. André,* Rev. d'Entomol., 1893, p. 152.

26 **Odontomachus hæmatodes** *L.* subsp. **insularis** *Guérin.*

Cuba.—*Guérin,* Iconogr. Régn. Animal, VII, Insect., 1845, p. 423, No. 2. ☿.—*Ramon,* Hist. fis. Cuba, VII, 1857, p. 757, T. 18, fig. 7, ☿ ♀ ♂.—*Roger,* Berl. Ent. Zeitschr., V, 1861, p. 26, No. 80. ☿ ♂.
Grenada.—*Forel,* Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ♀ ♂.

27. **Odontomachus hæmatodes** *L.* subsp. **insularis** *Guérin* var. **hirsutiusculus** *F. Smith.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 354, 355. ☿ ♀.
Grenada.—*Forel,* Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ♀.

28. **Odontomachus hæmatodes** *L.* subsp. **insularis** *Guérin* var. **pallens** *Wheeler.*

Andros.—*Wheeler, antea,* p. 83. ☿ ♀ ♂.
New Providence.—*Ibid.,* p. 83. ☿ ♀ ♂.
Cuba.—*Ibid.,* p. 83. ☿.

29. **Odontomachus hæmatodes** *L.* subsp. **insularis** *Guérin* var. **ruginodis** *Wheeler.*

New Providence.—*Wheeler, antea,* p. 82. ☿ ♀.
Cuba.—*Ibid.,* p. 82. ☿.

Subfamily DORYLINÆ.

30. **Eciton antillanum** *Forel.*

Grenada.—*Forel,* Trans. Ent. Soc. London, 1897, Pt. 3, pp. 299, 300. ☿.

31. **Eciton burchelli** *Westwood* var. **urichii** *Forel.*

Trinidad.—Three workers collected by Prof. Forel (Coll. Am. Mus. Nat. Hist.).

32. **Eciton klugi** *Shuck.*

St. Vincent.—*Shuckard,* Ann. Mag. Nat. Hist., 1, ser., vol. 260, 8, 1840. ♂.—*Westwood,* Arcan. Ent., I, 2, 1842, p. 75, No. 3. ♂.
Grenada.—*Forel,* Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ♂.

Subfamily MYRMICINÆ.

33. **Pseudomyrma championi** *Forel* subsp. **haytiana** *Forel.*

Hayti.—*Forel,* Ann. Soc. Ent. Belg., XLV, 1901, p. 342. ☿.

34. **Pseudomyrma delicatula** *Forel.*

Jamaica.—*Forel,* Biol. Centr.-Am., Formicidæ, 1899–1900, p. 93. ☿ ♀.
St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, p. 389. ☿ (erroneously described as *P. flavidula* F. Sm.).

35. **Pseudomyrma delicatula** *Forel* var. **capperi** *Forel.*

Jamaica.—*Forel,* Biol. Centr.-Am., Formicidæ, 1899–1900, p. 93. ☿.

36. **Pseudomyrma elongata** *Mayr.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, p. 390. ☿.
Andros.—*Wheeler, antea,* p. 86. ☿ ♀ ♂.
New Providence.—*Ibid.,* p. 86. ☿ ♀ ♂.

37. **Pseudomyrma elongata** *Mayr.* var. **cubaënsis** *Forel.*

Cuba.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 342. ☿.

38. **Pseudomyrma flavidula** *F. Smith.*

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ☿.
Andros.—*Wheeler, antea*, p. 85. ☿ ♀ ♂.
New Providence.—*Ibid.*, p. 85. ☿ ♀ ♂.

39. **Pseudomyrma pallida** *F. Smith.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 92.

40. **Pseudomyrma pilosula** *F. Smith.*

Barbados.—*F. Smith*, Trans. Ent. Soc. London, 1877, pp. 62, 63. ☿.

41. **Pseudomyrma variabilis** *F. Smith.*

Barbados.—*F. Smith*, Trans. Ent. Soc. London, 1877, p. 62. ☿.

42. **Xenomyrmex stolli** *Forel* subsp. **floridanus** *Emery* var. **lucayanus** *Wheeler.*

Andros.—*Wheeler, antea*, p. 87. ☿.

43. **Monomorium carbonarium** *F. Smith* subsp. **ebeninum** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 388. ☿ ♀.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ☿ ♀ ♂.
Guadeloupe.—Several workers collected by Prof. Forel (Coll. Am. Mus. Nat. Hist.).
Andros.—*Wheeler, antea*, p. 88. ☿ ♀.
New Providence.—*Ibid.*, p. 88. ☿ ♀ ♂.

44. **Monomorium cinnabari** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 199, 200. ☿.

45. **Monomorium destructor** *Jerdon.*

Jamaica.—*Er. André*, Rev. d'Entomol., 1893, p. 152.

46. **Monomorium omnivorum** (*L.*) *Emery.*

Jamaica.—*Browne*, Nat. Hist. Jamaica, 1756, p. 440.
Barbados.—*Schomburgk*, Hist. of Barbados, 1848, p. 639.

47. **Monomorium floricola** *Jerdon.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 199. ☿ ♀ (described as *M. pœcilum* Roger).
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 388, 389. ☿ ♀ ♂.
Jamaica.—Workers collected by Prof. L. H. Clarke (Coll. Am. Mus. Nat. Hist.).
Barbados.—Workers collected by Prof. Forel (Coll. Am. Mus. Nat. Hist.).
Andros.—*Wheeler, antea*, p. 87. ☿ ♀.
New Providence.—*Ibid.*, p. 87. ☿ ♀ ♂.

48. **Monomorium pharaonis** *L.*

New Providence.—*Wheeler, antea*, p. 89. ☿.

49. **Monomorium salomonis** *L.*

New Providence.—*Wheeler, antea*, p. 89. ☿.

50. Cardiocondyla emeryi *Forel.*

St. Thomas.—*Forel*, Formicides *in* Grandidiér's Hist. Phys. Nat. et Polit. de Madagascar, XX, 1891, pp. 160, 161.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 389. ☿.
New Providence.—*Wheeler*, *antea*, p. 89. ☿.

51. Solenopsis azteca *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 390. ☿.

52. Solenopsis castor *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 391, 392. ☿ ♀.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♀.

53. Solenopsis corticalis *Forel* var. virgula *Forel.*

Cuba.—*Forel*, Ann. Soc. Ent. Belg., XLVIII, 1904, p. 172. ♀.

54. Solenopsis exigua *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 395. ☿.

55. Solenopsis geminata *Fabr.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., 6, 1862, p. 290.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 396–398. ☿ ♀ ♂.
Jamaica.—*Er. André*, Rev. d'Entomol., 1893, p. 152.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ☿ ♀.
Puerto Rico.—Numerous workers in Coll. Am. Mus. Nat. Hist.
New Providence.—*Wheeler*, *antea*, p. 90. ☿ ♀ ♂.

56. Solenopsis globularia *F. Smith.*

St. Thomas.—*Forel*, Mitth. Münch. Ent. Ver., I, 1881, p. 11, No. 11. ☿; Bull. Soc. Vaud. Sc. Nat., (2) XX, pl. xci, 1884, p. 376.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 395, 396. ☿ ♀.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♀ ♂.
Andros.—*Wheeler*, *antea*, p. 89. ☿.

57. Solenopsis pollux *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 393–395. ☿ ♀ ♂.

58. Solenopsis succinea *Emery.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 398. ☿ ♀ ♂.

59. Pheidole androsana *Wheeler.*

Andros.—*Wheeler*, *antea*, p. 91. ♃ ☿.

60. Pheidole cubaënsis *Mayr.*

Cuba.—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, Jahrg., 1862, pp. 99, 100. ♃ ☿.

61. Pheidole decem *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 366, 367. ♃.

62. Pheidole fallax *Mayr.*

Cuba.—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, XX, 1870, pp. 980, 984. ♃.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♃ ☿.
Jamaica.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 355, 356.

63. **Pheidole fallax** *Mayr* var. **jelskii** *Mayr*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 400, 401. ♃ ☿ ♀ ♂.

Trinidad; Little Antilles.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 356.

New Providence.—***Wheeler, antea***, p. 92. ♃ ☿ ♀ ♂.

64. **Pheidole flavens** *Roger*.

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 198. ♃ ☿.

Andros.—***Wheeler, antea***, p. 92. ♃ ☿ ♀ ♂.

New Providence.—*Ibid.*, p. 93. ♃ ☿ ♀ ♂.

65. **Pheidole flavens** *Roger* var. **vincentensis** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 411–414. ♃ ☿ ♀ ♂.

66. **Pheidole flavens** *Roger* subsp. **sculptior** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 414, 415. ♃ ☿ ♀.

Martinique.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 366. ♃ ☿.

"West Indies."—*Forel*, Mitth. Naturhist. Mus. Hamburg, XVIII, Beiheft Jahrb. Hamb. Wiss. Anst., 18, 1901, p. 82.

67. **Pheidole flavens** *Roger* subsp. **sculptior** *Forel* var. **grenadensis** *Forel*.

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♃ ☿ ♀ ♂.

68. **Pheidole flavens** *Roger* subsp. **gracilior** *Forel*.

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 366. ♃ ☿.

"West Indies."—*Forel*, Mitth. Naturhist. Mus. Hamburg, XVIII, Beiheft, Jahrb. Hamb. Wiss. Anst., 1901, p. 78.

69. **Pheidole godmani** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 404–406. ♃ ☿ ♀.

70. **Pheidole guilelmi-mülleri** *Forel* subsp. **antillana** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 401–404. ♃ ☿ ♀ ♂.

71. **Pheidole guilelmi-mülleri** *Forel* subsp. **antillana** *Forel* var. **nigrescens** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 404. ♃ ☿ ♀.

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♃ ☿ ♀ ♂.

72. **Pheidole megacephala** *Fabr*.

Bahamas.—*Emery*, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 294.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 417, 418. ♃ ☿ ♀.

Jamaica.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 342. ♃ ☿.

Cuba.—♃ ☿ ♀ in the Coll. Am. Mus. Nat. Hist. (C. F. Baker).

73. **Pheidole orbica** *Forel*.

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 415–417. ♃ ☿ ♀ ♂.

74. **Pheidole punctatissima** *Mayr* subsp. **annectens** *Wheeler*.

Andros.—***Wheeler, antea***, p. 93. ♃ ☿ ♀.

75. Pheidole punctatissima *Mayr* subsp. **insulana** *Wheeler.*

Andros.—*Wheeler, antea,* p. 94. ♃ ☿.
New Providence.—*Wheeler, antea,* p. 94.

76. Pheidole radoszkowskii *Mayr* var. **luteola** *Forel.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 406–408. ♃ ☿ ♀ ♂.

77. Pheidole radoszkowskii *Mayr* var. **opacissima** *Forel.*

Jamaica.—*Forel,* Ann. Soc. Ent. Belg., XLV, 1901, p. 364. ♃ ☿.

78. Pheidole subarmata *Mayr.*

St. Lucia.—*Forel,* Ann. Soc. Ent. Belg., XLV, 1901, p. 365.

79. Pheidole subarmata *Mayr* var. **elongatula** *Forel.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 408–410. ♃ ☿ ♀ ♂.

80. Pheidole subarmata *Mayr* var. **nassavensis** *Wheeler.*

New Providence.—*Wheeler, antea,* p. 92. ♃ ☿.

81. Pheidole susannæ *Forel* subsp. **obscurior** *Forel.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 410, 411. ♃ ☿ ♀ ♂.

82. Cremastogaster ashmeadi *Mayr.*

Andros.—*Wheeler, antea,* p. 94. ☿.

83. Cremastogaster brevispinosa *Mayr* subsp. **minutior** *Forel.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, pp. 399, 400. ☿ ♀.
Grenada.—*Forel,* Trans. Ent. Soc. London, 1897, Pt. 3, p. 300.

84. Cremastogaster curvispinosa *Mayr* var. **antillana** *Forel.*

St. Vincent.—*Forel,* Trans. Ent. Soc. London, 1893, Pt. 4, p. 399. ☿.

85. Cremastogaster erecta *Mayr.*

Dominica.—*Mayr,* Verh. k. k. zool. bot. Ges. Wien, XVI, 1866, p. 902, pl. xx, fig. 12. ☿; Verh. k. k. zool. bot. Ges. Wien, XX, 1870, p. 991. ☿.

86. Cremastogaster lucayana *Wheeler.*

Andros.—*Wheeler, antea,* p. 95. ☿ ♀.
New Providence.—*Ibid.,* p. 95. ☿.,

87. Cremastogaster lucayana *Wheeler* var. **etiolata** *Wheeler.*

Andros.—*Wheeler, antea,* p. 96. ☿ ♀.

88. Cremastogaster sanguinea *Roger.*

Cuba.—*Roger,* Berl. Ent. Zeitschr., VII, 1863, p. 208. ☿.

89. Cremastogaster vicina *Er. André.*

Jamaica.—*Er. André,* Rev. d'Entomol., 1893, pp. 151, 152. ☿.

90. Cremastogaser victima *F. Smith* var. **steinheili** *Forel.*

St. Thomas.—*Forel,* Mitth. Münch. Ent. Ver., V, 1, 1881, p. 15, No. 13. ☿.—*Emery,* Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 288, note.

Jamaica.—Worker and female collected by Prof. Forel (Coll. Am. Mus. Nat. Hist.).
Andros.—*Wheeler, antea*, p. 96. ☿ ♀ ♂.

91. Pogonomyrmex schmitti *Forel.*

Hayti.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 339, 340. ☿.

92. Macromischa androsana *Wheeler.*

Andros.—*Wheeler, antea*, p. 98. ☿.

93. Macromischa iris *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 188. ☿.

94. Macromischa lucayensis *Forel.*

Bahamas.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 340–342. ♀.

95. Macromischa lugens *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 188, 189. ☿.

96. Macromischa pastinifera *Emery.*

Bahamas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXVII, 1896, p. 28., pl. i, fig. 18. ☿.

97. Macromischa pastinifera *Emery* var. opacipes *Wheeler.*

Andros.—*Wheeler, antea*, p. 96. ☿.

98. Macromischa porphyritis *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 185, 186. ☿.

99. Macromischa pulchella *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXVII, 1896, pp. 26, 27. ☿ ♀.

100. Macromischa punicans *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 189, 190. ☿.

101. Macromischa purpurata *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 184, 185. ☿.

102. Macromischa sallei *Guérin.*

San Domingo.—*Guérin*, Rev. et Magaz. Zool. (2), pl. iv., 1852, p. 73.—*Nylander*, Ann. Sc. Nat. (4), pl. v, 1856, p. 82.—*Roger*, Berl. Ent. Zeitschr., VI, 1862, p. 293, No. 29.—*Forel*, Biol. Centr.-Am. Formicidæ, 1899–1900, p. 57, note; Bull. Soc. Ent. Suisse, X, 7, p. 272.

103. Macromischa splendens *Wheeler.*

New Providence.—*Wheeler, antea*, p. 100. ☿ ♀ ♂.

104. Macromischa squamifera *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 186, 187. ☿.

105. Macromischa versicolor *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 187, 188. ☿.

106. Rogeria curvipubens *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXVII, 1896, pp. 54, 55. ☿ ♀.
Andros.—*Wheeler, antea*, p. 100. ☿.

107. Rogeria foreli *Emery.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 383. ☿.
St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXVII, 1896, p. 55. ☿.

108. Tetramorium guineense *Fabr.*

San Domingo.—*Guérin*, Rev. et Mag. Zool. (2), 4, 1852, p. 79. ☿.—*Roger*, Berl. Ent. Zeitschr., V, 1861, p. 171.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 382. ☿.
Andros.—*Wheeler*, *antea*, p. 100. ☿.

109. Tetramorium lucayanum *Wheeler.*

New Providence.—*Wheeler*, *antea*, p. 101. ☿.

110. Tetramorium simillimum *Nylander.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 382. ☿ ♀.
Andros.—*Wheeler*, *antea*, p. 101. ☿ ♀ ♂.
New Providence.—*Ibid.*, p. 101. ☿ ♀ ♂.

111. Wasmannia auropunctata *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 182, 185. ☿ ♀ ♂.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 383–386. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ☿ ♀ ♂.

112. Wasmannia sigmoidea *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 386–388. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♀.

113. Cryptocerus atratus *Linn.*

St. Thomas.—*Forel*, Mitth. Naturhist. Mus. Hamburg, XVIII, Beiheft, Jahrb. Hamb. Wiss. Anst., 1901, p. 50. ☿.

114. Cryptocerus hamulus *Roger.*

San Domingo.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 209, 210. ☿.

115. Cryptocerus hamulus *Roger* var. haytianus *Forel.*

Hayti.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, pp. 337, 338. ☿.

116. Cryptocerus hæmorrhoidalis *Latr.*

San Domingo.—*Latreille*, Hist. Nat. Fourmis, 1802, p. 276. ☿.—*Lepeletier* Hist. Nat. Ins. Hymenopt., II, 1836, p. 172, No. 2.

117. Cryptocerus minutus *Fabr.*

St. Thomas.—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, Jahrg., 1862, p. 116.

118. Cryptocerus pallens *Klug* var. araneolus *Smith.*

St. Vincent.—*F. Smith*, Trans. Ent. Soc. London (2), 2, Pt. 7, 1854, p. 223, No. 27, pl. xix., fig. 4. ☿; Trans. Ent. Soc. London (3), I, Pt. 4, 1862, p. 411, No. 29. ☿.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 382. ☿.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ☿.

119. Cryptocerus varians *F. Smith.*

Cuba.—*F. Smith*, Trans. Ent. Soc. London, 1876, p. 606, No. 4, pl. xi, fig. 6. ☿.
Andros.—*Wheeler*, *antea*, p. 104. ♃ ☿ ♀ ♂.

120. Strumigenys alberti *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 380, 381. ☿ ♀.

121. Strumigenys eggersi *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXII, 1890, p. 32, pl. vii, fig. 9. ☿ ♀.

122. Strumigenys eggersi *Emery* var. **vincentensis** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 378. ☿.

123. Strumigenys gundlachi *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1862, pp. 253, 254. ☿ (excl. ♀).

124. Strumigenys imitator *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 377. ☿.

125. Strumigenys lanuginosa *Wheeler.*

New Providence.—*Wheeler, antea*, p. 105. ☿ ♀.

126. Strumigenys margaritæ *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 378–380. ☿ ♀ ♂.

127. Strumigenys membranifera *Emery* subsp. **simillima** *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXII, 1890, pp. 32, 33, pl. viii, fig. 5. ☿.

128. Strumigenys rogeri *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXII, 1890, pp. 31, 32, pl. vii, fig. 6. ☿.
St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 378. ☿ ♀.

129. Strumigenys smithii *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 375–377. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♀.

130. Epitritus emmæ *Emery.*

St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXII, 1890, p. 33, pl. viii, fig. 6. ☿.

131. Apterostigma mayri *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XXXVII, 1893, pp. 604, 605. ☿.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, pp. 180, 181.

132. Apterostigma urichii *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XXXVII, 1893, pp. 603, 604. ☿.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, p. 180.

133. Cyphomyrmex foxii *Er. André.*

Jamaica.—*Er. André*, Rev. d'Entomol., XI, 1892, p. 55. ☿.

134. **Cyphomyrmex rimosus** *Spinola.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 374, 375. ☿ ♀ ♂.
Trinidad.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, p. 181.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 300. ♀.

135. **Cyphomyrmex rimosus** *Spinola* subsp. **minutus** *Mayr.*

Cuba.—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, Jahrg., 1862, p. 691. ☿.
St. Thomas.—*Emery*, Bull. Soc. Ent. Ital. Ann., XXVIII, 1896, p. 90. ♂.
New Providence.—*Wheeler*, *antea*, p. 106. ☿ ♀ ♂.

136. **Sericomyrmex opacus** *Mayr.*

Trinidad.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, p. 179; Trans. Ent. Soc. London, Pt. 1, Apr. 1895, pp. 77, 78.

137. **Atta cephalotes** *Linn.*

Trinidad.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, pp. 175–177.

138. **Atta cephalotes** *L.* var. **lutea** *Forel.*

Barbados.—*Forel*, Ann. Soc. Ent. Belg., XXXVII, 1893, pp. 587, 588. ☿.

139. **Atta insularis** *Guérin.*

Cuba.—*Guérin*, Iconogr. Régn. Animal, VII, Insect., 1845, p. 422, No. 3. ☿.—*Mayr*, Reise d. Novara, II, 1, Formicidæ, 1865, p. 82, ☿ ♀ ♂.

140. **Atta sexdens** *Linn.*

Trinidad.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, p. 175.

141. **Atta (Acromyrmex) octospinosa** *Reich.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XXXVII, 1893, pp. 594–596. ☿ ♀ ♂.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, pp. 177, 178.

142. **Atta (Trachymyrmex) jamaicensis** *Er. André.*

Jamaica.—*Er. André*, Rev. d'Entomol., 1893, p. 149. ☿.

143. **Atta (Trachymyrmex) maritima** *Wheeler.*

Andros.—*Wheeler*, *antea*, p. 108. ☿.
New Providence.—*Ibid.*, p. 108. ☿.

144. **Atta (Trachymyrmex) sharpii** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 372, 373. ☿.

145. **Atta (Trachymyrmex) urichii** *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XXXVII, 1893, pp. 601, 602. ☿ ♂.—*Urich*, Trinidad Field Nat. Club, II, No. 7, Apr. 1895, pp. 178, 179.

146. **Atta (Mycocepurus) smithii** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 370–372. ☿.

Subfamily DOLICHODERINÆ.

147. **Dolichoderus bidens** *Linn.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLVII, 1903, pp. 257, 258.

148. **Dolichoderus bidens** *Linn.* var. **spurius** *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLVII, 1903, p. 258. ☿ ♀.

149. **Dolichoderus bispinosus** *Oliv.*

St. Thomas.—*Mayr*, Verh. k. k. zool. bot. Ges. Wien, Jahrg., 1862, pp. 59, 60. ☿; *ibid.*, pp. 707, 708. , ♀ =*Hypoclinea vestita* Mayr.).

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 98, 99.

150. **Dolichoderus lutosus** *F. Smith* var. **nigriventris** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 351. ☿.

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 99, 100.

151. **Azteca alfaroi** *Emery* subsp. **lucidula** *Forel.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 113. ☿ ♀ ♂.

152. **Azteca chartifex** *Forel.*

Trinidad.—*Forel*, Boll. Mus. Zool. Torino, XI, No. 230, p. 4, nota, fig. 5, 1896; Biol. Centr.-Am., Formicidæ, 1899–1900, p. 117.

153. **Azteca delpini** *Emery* subsp. **antillana** *Forel.*

St. Lucia.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 111. ☿.

154. **Azteca delpini** subsp. **antillana** var. **guadeloupensis** *Forel.*

Guadeloupe.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 111. ☿.

155. **Azteca foreli** *Emery* subsp. **ursina** *Forel.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 112. ♀ ♂.

156. **Azteca velox** *Forel* var. **trinidadensis** *Forel.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 109. ☿ ♀.

157. **Tapinoma litorale** *Wheeler.*

Andros.—*Wheeler*, *antea*, p. 110. ☿ ♀ ♂.

New Providence.—*Ibid.*, p. 110. ☿ ♀ ♂.

158. **Tapinoma melanocephalum** *Fabr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 352. ☿ ♀.

Jamaica.—*Er. André*, Rev. d'Entomol., 1893, p. 152.

Andros.—*Wheeler*, *antea*, p. 110. ☿ ♀.

159. **Tapinoma pruinosum** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 165. ☿.

"Bahamas."—*Emery*, Zool. Jahrb., Abth. f. Syst., VIII, 1894, p. 333. ☿.

Andros.—*Wheeler*, *antea*, p. 110. ☿.

160. **Dorymyrmex pyramicus** *Roger.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 352, 353. ☿ ♂.

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿.

161. **Dorymyrmex pyramicus** *Roger* var. **niger** *Pergande.*

Andros.—*Wheeler*, *antea*, p. 111. ☿.

New Providence.—*Ibid.*, p. 111. ☿.

162. **Forelius maccooki** *Forel.*

Jamaica.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 102, 103.

163. Iridomyrmex analis *Er. André.*

Cuba.—Three workers in collection Am. Mus. Nat. Hist. (C. F. Baker).

164. Iridomyrmex iniquus *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 351. ☿.

Subfamily CAMPONOTINÆ.

165. Plagiolepis flavidula *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 162. ☿.

166. Acropyga (Rhizomyrma) smithii *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 349. ♀.

167. Brachymyrmex heeri *Forel.*

Andros.—*Wheeler, antea*, p. 111. ☿ ♀.

168. Brachymyrmex heeri *Forel* var. **obscurior** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 345, 346. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, p. 298. ☿ ♂.
Andros.—*Wheeler, antea*, p. 111. ☿ ♀ ♂.
New Providence.—*Ibid.*, p. 111. ☿ ♀ ♂.

169. Brachymyrmex minutus *Forel.*

St. Thomas and St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 346, 347. ☿ ♀.
Andros.—*Wheeler, antea*, p. 111. ☿ ♀.

170. Myrmelachista ambigua *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 349, 350. ☿.

171. Myrmelachista kraatzii *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 163. ☿.

172. Myrmelachista rogeri *Er. André.*

Cuba.—*Er. André*, Rev. d'Entomol., VI, 1887, p. 288. ☿.

173. Prenolepis anthracina *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 161, 162. ☿.

174. Prenolepis gibberosa *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 161. ☿.

175. Prenolepis fulva *Mayr.*

Hayti.—*Forel*, Mitth. Naturhist. Mus. Hamb., XVIII, Beiheft, Jahrb. Hamb. Wiss. Anst., 1901, p. 65.

176. Prenolepis fulva *Mayr* subsp. **pubens** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 338, 339. ☿ ♀ ♂.

177. Prenolepis guatemalensis *Forel* subsp. **antillana** *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 340–342. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, Sept., p. 298. ☿ ♀ ♂.
Andros.—*Wheeler, antea*, p. 111. ☿ ♀ ♂.
New Providence.—*Ibid.*, p. 111. ☿ ♀ ♂.

178. Prenolepis longicornis *Mayr.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 337, 338. ☿ ♀ ♂.
Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, Sept., p. 298. ☿ ♀.
Andros.—*Wheeler, antea*, p. 111. ☿ ♀.
New Providence.—*Ibid.*, p. 111. ☿ ♀.

179. Prenolepis nodifera *Mayr.*

Antilles.—*Dalla Torre*, Catalog. Hymenopt., VII, 1893, p. 179.

180. Prenolepis steinheili *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, p. 342. ☿.

181. Prenolepis steinheili *Forel* var. minuta *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 343–345. ☿ ♀ ♂.

182. Prenolepis *sp.*

Andros.—*Wheeler, antea*, p. 112. ☿.

183. Camponotus abdominalis *Fabr.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLVI, 1902, p. 170.

184. Camponotus abdominalis *Fabr.* opaciceps *Roger.*

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, Sept., p. 297. ☿ ♀ ♂.

185. Camponotus abdominalis *Fabr.* subsp. sharpi *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 335–337. ♃ ☿ ♀ ♂; Biol. Centr.-Am., Formicidæ, 1899–1900, p. 133.

186. Camponotus auricomus *Roger* var. lucianus *Forel.*

St. Lucia.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 139. ☿ ♀; Ann. Soc. Ent. Belg., XLVI, 1902, p. 172.

187. Camponotus auricomus *Roger* var. vincentensis *Forel.*

St. Vincent.—*Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 334, 335. ☿ ♀; Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 139, 140.

188. Camponotus brettesi *Forel.*

Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLVI, 1902, p. 171.

189. Camponotus capperi *Forel.*

Jamaica.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 138. ♃ ☿.

190. Camponotus capperi *Forel* var. corticalis *Forel.*

Jamaica.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p. 138. ☿; Ann. Soc. Ent. Belg., XLVI, 1902, p. 172.

191. Camponotus chazaliei *Forel.*

St. Lucia.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 149, 150. ☿; Ann. Soc. Ent. Belg., XLVI, 1902, p. 172.

192. Camponotus claviscapus *Forel.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 152, 153. ♃ ☿ ♂.

193. Camponotus conspicuus *F. Smith.*

Jamaica.—*F. Smith*, Cat. Hymenopt. Brit. Mus., VI, 1858, p. 48, No. 159 ♀.
Trinidad.—*Forel*, Ann. Soc. Ent. Belg., XLVI 1902, p. 171.

194. Camponotus fragilis *Pergande* var.

Hayti.—*Forel*, Ann. Soc. Ent. Belg., XLV, 1901, p. 371. ☿.

195. Camponotus fugax *Forel.*

Jamaica.—*Forel*, Ann. Soc. Ent. Belg., XLVI, 1902, pp. 173, 174. ♃ ☿.

196. Camponotus fumidus *Roger.*

Hayti.—*Dalla Torre* Catalog. Hymenopt., VII, 1893, p. 232.

197. Camponotus gilviventris *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 145, 146. ☿.

198. Camponotus hannani *Forel.*

Jamaica.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 131, 132, nota. ♃ ☿; Ann. Soc. Ent. Belg., XLVI, 1902, p. 170.

199. Camponotus hannani *Forel* subsp. **willardi** *Forel.*

Jamaica.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, p 132, nota. ☿.

200. Camponotus inæqualis *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 147, 148. ♃ ☿ ♀.

201. Camponotus inæqualis *Roger* var. **ramulorum** *Wheeler.*

Andros and New Providence.—*Wheeler, antea*, p. 116. ♃ ☿ ♀ ♂.
Cuba.—*Ibid.*, p. 116.

202. Camponotus inæqualis *Roger* var. **marcidus** *Wheeler.*

Andros.—*Wheeler, antea*, p. 117. ♃ ☿ ♀ ♂.

203. Camponotus landolti *Forel* subsp. **zonatus** *Emery* var. **eburneus** *Wheeler.*

New Providence.—*Wheeler, antea*, p. 117. ♃ ☿ ♀.

204. Camponotus maculatus *Fabr.* subsp. **lucayanus** *Wheeler.*

Andros and New Providence.—*Wheeler, antea*, p. 113. ♃ ☿ ♀.

205. Camponotus maculatus *Fabr.* subsp. **lucayanus** *Wheeler* var. **tephronotus** *Wheeler.*

Andros and New Providence.—*Wheeler, antea*, p. 114. ♃ ☿ ♀ ♂.

206. Camponotus maculatus *Fabr.* subsp. **soulouquei** *Forel.*

Hayti.—*Forel*, Mitth. Naturhist. Mus. Hamb., XVIII, Beiheft. Jahrb. Hamb. Wiss. Anst., 1901, p. 68. ♃.

207. Camponotus planatus *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 148, 149. ☿ ♀ ♂. *Forel*, Bull. Soc. Vaud. Sci. Nat. (2), XVI, 1879, p. 97. ♃ ☿; *ibid.*, XX, 1884, p. 346; Ann. Soc. Ent. Belg., XLV, 1901, p. 371. ☿.

208. Camponotus ruficeps *Fabr.* (=*sexguttatus Fabr.*).

St. Croce.—*Fabricius*, Syst. Piez., 1804, p. 401.

St. Vincent.—*F. Smith*, Cat. Br. Mus. Formicid., p. 50, No. 171, 1858. ♃ ☿ (=*bimaculatus* F. Sm.). *Forel*, Trans. Ent. Soc. London, 1893, Pt. 4, pp. 333, 334. ♃ ☿ ♀.

St. Thomas.—*Emery*, Boll. Mus. Zool. Anat. Comp. R. Univ. Torino, IX, No. 187, 1894, p. 1.

Martinique, Guadeloupe, Barbados, St. Lucia.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, Sept., pp. 297, 298; Ann. Soc. Ent. Belg., XLVI, 1902, p. 172.

209. **Camponotus ruficeps** *Fabr.* var. **grenadensis** *Forel.*

Grenada.—*Forel*, Trans. Ent. Soc. London, 1897, Pt. 3, Sept., p. 297. ♃ ☿ ♀ ♂.
Barbados.—*Forel*, Ann. Soc. Ent. Belg., XLVI, 1902, pp. 172, 173.

210. **Camponotus sphæralis** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 147. ☿.

211. **Camponotus sphæricus** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, p. 146. ☿.

212. **Camponotus saussurei** *Forel.*

St. Thomas.—*Forel*, Bull. Soc. Vaud. Sc. Nat. (2), XVI, P. 81, 1879, p. 103, pl. i, fig. 3. ☿.

213. **Camponotus urichii** *Forel.*

Trinidad.—*Forel*, Biol. Centr.-Am., Formicidæ, 1899–1900, pp. 155, 156. ♃ ☿ ♀.

214. **Camponotus ustus** *Forel.*

St. Thomas.—*Forel*, Bull. Soc. Vaud. Sc. Nat. (2), XVI, P. 81, 1879, p. 75. ☿ ♀ ♂; Mitth. Naturhist. Mus. Hamb., XVIII, Beiheft Jahrb. Hamb. Wiss. Anst., 1901, p. 70. ☿ ♀.

215. **Camponotus zoc** *Forel.*

Trinidad.—*Forel*, Bull. Soc. Ent. Suisse, X, 7, p. 285; Biol. Centr.-Am., Formicidæ, 1899–1900, p. 142. ☿; Ann. Soc. Ent. Belg., XLVI, 1902 p. 171.

216. **Camponotus (Colobopsis) culmicola** *Wheeler.*

Andros.—*Wheeler, antea*, p. 119. ♃ ☿ ♀ ♂.
New Providence.—*Ibid.*, p. 119. ♃ ☿ ♀ ♂.

217. **Camponotus (Colobopsis) riehlii** *Roger.*

Cuba.—*Roger*, Berl. Ent. Zeitschr., VII, 1863, pp. 159, 160. ♀.

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Article IX. — ON THE GROUP OF FOSSIL TURTLES KNOWN AS THE AMPHICHELYDIA; WITH REMARKS ON THE ORIGIN AND RELATIONSHIPS OF THE SUBORDERS, SUPERFAMILIES, AND FAMILIES OF TESTUDINES.

By Oliver P. Hay.[1]

The group of turtles called the Amphichelydia was established by Mr. R. Lydekker in the year 1889 and made to include, as the author states, a number of generalized later Mesozoic forms which may be regarded as allied to the earlier and at present unknown progenitors of the Pleurodira and Cryptodira. The characters of the group were derived almost wholly from the shell, and this is said to be constructed on the plan of that of the Cryptodira and Pleurodira, in which mesoplastral bones and an intergular shield are developed and the pubis may be articulated without sutural union with the xiphiplastral. The coracoid and humerus, when known, are stated to be of the pleurodiran type. The genera included in this group by Mr. Lydekker are *Pleurosternon*, *Platychelys*, *Helochelys*, *Baëna*, *Archæochelys*, and the very imperfectly known genera *Protochelys* and *Chelytherium*. *Pleurosternon* is to be regarded as the type of the group. The presence of a mesoplastron was regarded as an essential character of the superfamily. Mr. Lydekker's remarks and conclusions on this subject are to be found in the Quarterly Journal of the Geological Society of London, Volume XLV, 1889, pp. 511–518, and in his Catalogue of Fossil Reptilia and Amphibia, pt. iii, p. 204.

In 1890 (Amer. Naturalist, XXIV, pp. 530–536) and again in 1891 (Proc. Acad. Nat. Sci. Phila., 1891, pp. 411–430) Dr. George Baur published the results of his studies on the skeleton of *Compsemys plicatula*, specimens of which had been obtained by Prof. Marsh in the Upper Jurassic of Como, Wyoming. Dr. Baur was enabled to describe almost all parts of the osteology of this ancient turtle. He accepts Lydekker's group Amphichelydia, gives it the rank of a suborder, and assigns to it the following characters:

> "Nasals free, a squamoso-parietal arch; descending processes of the prefrontals joining vomer; stapes in an open groove of the quadrate; pterygoids narrow in the middle, without wing-like lateral expansions, separating quadrate and basisphenoid; epipterygoid well developed and free; dentary bones distinct. Cervical vertebræ with well-developed transverse processes, more

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[1] For the opportunity of preparing and publishing the following paper the writer is indebted to the Carnegie Institution of Washington.

in front of vertebra, with single articular faces, biconcave; dorsal vertebræ; sacral vertebræ with well-developed ribs; ribs of sacral vertebræ connected with centrum and neuroid. Pelvis not anchylosed to the carapace and plastron. Epiplastra in contact with hyoplastra, entoplastron oval or rhomboidal; a complete series of peripheralia connected with the ribs."

The skull is said to show characters such as we would expect to find in the ancestors of Cryptodira and Pleurodira; yet in specifying the pleurodiran characters this author mentions only the free nasals, the suturally united dentaries, and the "absence of a production of the petrosal."

In his paper of 1891 Dr. Baur discussed the genus *Baëna*, without however having any new materials. He concluded that it is closely related to *Compsemys plicatula*, being probably its direct successor and belonging to the Amphichelydia. Cope had recognized the pleurodiran affinities of *Baëna*, but had arranged it with the Cryptodira.

During the summer of 1903 the writer spent some weeks in the Bridger beds of Wyoming and gave his attention especially to the collecting of turtle remains. It was found that the genus *Baëna* is represented in these deposits by several species and great numbers of individuals. Among the many specimens obtained almost every portion of the osteology is represented. There are three or four quite complete skulls and others which are injured. The result of the investigation of these has been to confirm many of Baur's conclusions, to modify others, and to establish more firmly the validity of Mr. Lydekker's group. Besides the Bridger materials, the writer has had the opportunity of studying a very complete skull of the same genus from the Laramie deposits of Wyoming. This skull belongs to the Marsh collection in Yale University Museum, and has been described by the writer as *Baëna cephalica* (Hay, 1905, p. 263, pl. xii).

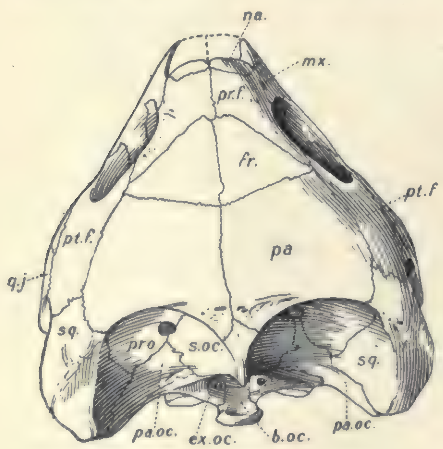

Fig. 1. Skull of *Baëna undata* seen from above. × ⅔.

The skull of *Baëna* is broad and short. The temporal region is extensively roofed over and there are, in the Bridger species, parieto-squamosal arches. In the Laramie species, called *Baëna cephalica*, the hinder border of the roof has been excavated to the postorbital bone, thus abrogating the union of the parietal and squamosal. Short, broad, nasals are present, and the prefrontals meet the postfrontals, so as to exclude the frontals from the rim of the orbits. There are present distinct lachrymals, elements hitherto, the writer believes, not recognized among the turtles. These occupy the position of those processes of the prefrontals which in other turtles descend to meet the vomer. The choanæ are far forward. The basisphenoid is large, extending forward nearly to the vomer. The pterygoids separate the quadrate from the basisphenoid. The basioccipital enters into the boundary of the foramen magnum. No portion of the exoccipitals enters into the occipital condyle. At the sides of the basisphenoid are foramina for the internal carotid arteries.

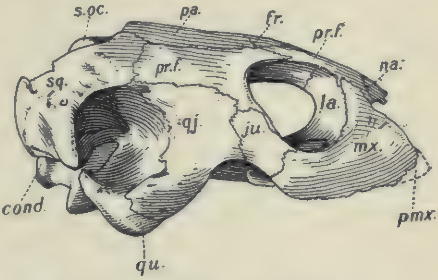

Fig. 2. Skull of *Baëna undata* seen from the side. $\times \frac{3}{5}$.

An examination of the skulls of *Compsemys* and *Baëna* shows, it seems to the writer, that where the characters are not primitive they are wholly, or almost wholly, cryptodiran. Baur accounted the presence of nasals among the pleurodiran characters; but nasals are absent among the Pelomedusidæ, while they are present in *Desmatochelys* and *Porthochelys*. Cryptodira of the Kansas Cretaceous. The lachrymals must be looked upon as a primitive character. The most distinctive skull character of modern Pleurodira is absent, the expansion of the pterygoids in front and their shortening behind, so as to permit the union of the quadrates and the basisphenoid.

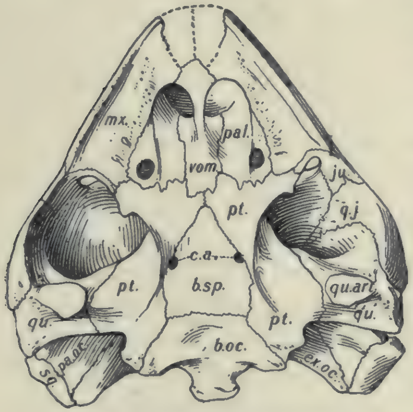

Fig. 3. Skull of *Baëna undata* seen from below. $\times \frac{3}{5}$.

Baur found that the cervical vertebræ of *Compsemys plicatula* are biconcave, and this observation is confirmed by a quite complete specimen in the American Museum of Natural History. Baur therefore gives as one of the characters of the Amphichelydia the presence of bicœlous cervicals. The cervicals of *Baëna undata*, however, are not so. Of the first cervical only the odontoid is present; it has the form seen in the Cryptodires, being convex in front, concave behind. The second and third are convexo-concave; the fifth to the eighth concavo-convex. Since the third is concave behind and the fifth concave in front, it might be supposed that the fourth would be doubly convex. On the contrary, it is bicœlous. Nevertheless, the articular ends are modified so that they are quite different from the concave ends of the other vertebræ. Instead of the borders of the cups being sharp, they are rounded off. It seems to the writer that we have here an illustration of the way in which concave articular surfaces have been transformed into convex. The borders surrounding the concavities have grown broader and more convex until the concavities have been abolished. When we come to study more carefully the articular ends of the centra of *Compsemys* we find that they resemble closely those of the fourth cervical of *Baëna*. Hence, even in the Jurassic a beginning had been made toward the development of convex vertebral centra. In a specimen of *Baëna arenosa*, of the Bridger beds, the anterior end of the second cervical is flat, the posterior end concave. The third has the front end slightly convex, with a central depression, the hinder end concave. The fourth is concave in front, flat behind. The fifth, sixth, and seventh are concave in front, flat behind. The eighth is concave in front, slightly convex behind.

The cervicals of both *Compsemys plicatula* and the species of *Baëna* possess well-developed transverse processes.

The manner in which the head and the neck are withdrawn for protection is widely different in the Cryptodira and the Pleurodira. In the former the neck is bent in the perpendicular plane which passes through the axis of the animal. The neck assumes curves which resemble those of the neck of birds. In the Pleurodira the neck is bent in a horizontal plane and the head is simply laid beneath the carapace against the shoulder. In this group the neck is bent like that of a snake. Hence, the Cryptodira might fitly be called the bird-necked turtles; the Pleurodira, the snake-necked turtles. What are the mechanical arrangements which facilitate these different modes of flexure? They may be easily comprehended by comparing the cervicals of *Hydromedusa* with those of a Trionychid. In the former the right and left zygapophysial articular surfaces are near each other and placed rather high above the centrum. The postzygapophysial surfaces coalesce. The result of these arrangements is to facilitate movements in a horizontal plane and to restrict those in a perpendicular plane. In the Trionychid the right and left zygapophyses are wide apart and placed low down. Thus movements in a horizontal plane are restricted. There is, also, a deep notch between the postzygapophyses, allowing them to ride astride of the next vertebra behind when the neck is strongly flexed. In the various turtles we find gradations in these arrangements here described, but the flexibility of the neck in the one plane or the other depends on them.

What is the condition of the cervicals of *Baëna* and of *Compsemys?* Not that of the Cryptodira, nor yet wholly that of the Pleurodira. The zygapophysial articular surfaces are high above the centra and not far removed from the axial plane, and there is no notch of great depth between the postzygapophyses. On these accounts, motion in a perpendicular plane must have been considerably restricted. On the other hand, the postzygapophyses did not coalesce, and hence motion in a horizontal plane was not so free as in the Pleurodira. It would therefore appear that motion was nearly equally free in all planes, and that possibly the neck and head were partly retracted and partly turned to one side beneath the edge of the shell.

Although all chelonians have in their necks the same number of vertebræ, namely, eight, the length of the neck varies greatly. Taking the length of the dorsal vertebræ as the unit, the length of the neck in five species is as follows:

Hydromedusa tectifera	1.31.
Chelydra serpentina	1.10.
Amyda spinifera	1.08.
Chrysemys elegans	.80.
Thalassochelys caretta	.54.

When the head of the Trionychid is retracted the basal half of the neck is carried far backward beneath the dorsal vertebræ, while the anterior half is carried forward beneath the basal half. When the head of *Hydromedusa* is to be protected, the neck is bent first toward one side, then toward the opposite side. The very short neck of *Thalassochelys* is flexed in a perpendicular plane, but it is so short that the head is not concealed.

Short as is the neck of *Thalassochelys*, that of *Baëna* was still shorter, forming only .513 of the length of the dorsal part of the vertebral column. It seems, therefore, that this dweller in fresh-water streams was able to protect its head less effectively than our marine turtles. The specimen of *Compsemys* in the American Museum of Natural History presents the hinder half of the neck. An estimate shows that the neck was equal in length to .62 of the dorsal vertebræ. Are we not justified in concluding from *Baëna* and *Compsemys* that the primitive turtles had very short necks?

When we come to compare the cervical vertebræ of *Thalassochelys* with those of *Baëna* we find many resemblances. Those of the modern sea-swimmer are, of course, far more specialized, and this in the direction of the Cryptodira; but it appears certain that they have retained many primitive features, one of which is their shortness.

The first dorsal vertebra has a concave anterior articular surface in both *Compsemys* and *Baëna*. It is to be noted that the ribs of this vertebra have the usual position against the anterior edge of the second ribs; but it is, in *Compsemys*, remarkable for its great length, extending away from the midline at least 65 mm. In *Baëna*, too, the first rib is longer than in modern turtles, except probably that of *Chelydra*.

As stated by Baur, the arrangement of the tenth ribs and the sacral vertebræ is exactly that of the Emydidæ and the Testudinidæ, and therefore cryptodiran and not pleurodiran. These statements apply equally well to *Baëna*. The sacral vertebræ resemble closely those of *Chelydra*. There has apparently been quite free motion between the last dorsal and the first sacral vertebræ. Baur has stated that the posterior articular surface of the last sacral of *Baëna* is concave, and from this has concluded that the caudal vertebræ were opisthocœlous. In the type of *Baëna arenosa* this surface is only slightly concave. In a specimen of another species of *Baëna* from the Bridger this surface is somewhat irregular. The upper half is very slightly concave; the lower half decidedly convex. Notwithstanding this condition, the anterior surface of the first caudal is a shallow concavity, while the posterior surface is deeply concave. The other vertebræ of the tail of this species, and of *B. arenosa*, are convexo-concave, as in *Chelydra*. Chevrons are present in probably all but three or four anterior ones. The transverse processes of the most anterior caudals are long and slender; but they are rapidly reduced; and at about the eighth caudal they disappear.

Baur has described the pelvis of *Compsemys plicatula* and *Baëna arenosa*. The present writer has not seen the *Compsemys* materials studied by Baur, but has examined the pelvis of the specimen in the American Museum of Natural History. Baur states that the true pubis is a slender element meeting that of the other side in the middle line, and that the ischia do not meet in the midline. The American Museum specimen shows that the pubes are fully as broad antero-posteriorly as in *Chrysemys*. There is a deep notch between them in front for the reception of the epipubic cartilage. It is not certain from the specimen referred to that the ischia joined the pubes between the pubo-ischiadic foramina, but apparently they did. A large species of *Baëna* from the Bridger has furnished a complete pelvis, in which all the bones are thoroughly coössified. The epipubic cartilage also is ossified as a long pointed process in front of the pubes. The pubes and ischia are united along the midline. As stated by Baur, the pelves of *Compsemys* and *Baëna* resemble each other very closely. They differ from the pelves of the Cryptodira and resemble those of the Pleurodira in the presence of backwardly directed ischiadic processes which rest on the xiphiplastra. As is well known, there is no sutural union of the pelvic bones with either the carapace or the plastron in either of the two genera. Scars on the xiphiplastra may mark the points of attachment of the pelvic bones, but there were no sutural articulations.

Mr. Lydekker states that the coracoid of *Pleurosternon* is of the pleurodiran type and much expanded distally. Baur too tells us that the coracoid of *Compsemys* is much expanded distally, as in *Chelys* and some other Pleurodira and in Testudinidæ. So far as can be judged from the somewhat damaged coracoids of the American Museum specimen of *Compsemys* these statements are true. On the other hand, the coracoids of *Baëna arenosa* are not so much expanded distally as are those of *Chrysemys*. At least, it can hardly be affirmed that the coracoids of the Amphichelydia are of the pleurodiran type.

The pedunculated head of the scapula resembles that of *Hydromedusa*.

The limbs of *Compsemys* and of *Baëna* were developed as walking organs; although they were doubtless furnished with webs between the toes, to fit them for swimming. The limbs, both the anterior and the posterior, were longer in proportion to the length of the shell than those of *Chrysemys elegans*, but considerably shorter than those of *Chelydra*. In *Compsemys* the femur is nearly an eighth longer than the humerus; in *Baëna* the two are of the same length. Lydekker regards the humerus as being of the pleurodiran type. Baur, on the other hand, states that the fore limbs resemble the elements of the Emydidæ, and especially compares the humerus with that of *Terrapene.*

In the year 1903, Dr. E. Fraas, of Stuttgart, published (Fraas, 1903) an extremely valuable and interesting paper in which he described a new species of *Thalassemys.* To this paper he added some general observations on the origin and relationships of the turtles. With many of Dr. Fraas's conclusions the present writer can heartily agree; from others he is compelled to dissent.

In more than one place in this paper Dr. Fraas speaks of the existence of Pleurodira in the Jurassic as definitely determined. More than this, he states (p. 100) that in *Proganochelys* we have a typical land-living Pleurodiran. The same opinion was expressed in his paper on *Proganochelys quenstedtii* (Fraas, 1899). As only the shell of this species is known, the present writer sees no reason why this species may not have been a member of the Amphichelydia; and the probabilities are in favor of this view. Only when the skull shall have been discovered and shown to have possessed pleurodiran characters, or at least when the pelvis shall have been proved to have been articulated suturally with the shell, may we venture to place it among the Pleurodira.

Dr. Fraas refers to a paper by Huene (Huene, 1902) in which are described the cervical vertebræ of two species of turtles from the Muschelkalk, *Chelyzoon latum* and *C. blezingeri.* Huene regarded these turtles as belonging probably to the Cryptodira, on account of the resemblance of the cervicals to those of the Chelydridæ. Dr. Fraas views the discovery as demonstrating the presence of Cryptodires in the Middle Trias. To my mind, there is in these vertebræ no especial resemblance to those of *Chelydra.* They resemble more those of *Baëna;* and there appears to be no good reason why they should not have belonged to some Amphichelydian, possibly to some species of *Proganochelys.*

In his latest paper Dr. Fraas (1903, p. 88) has presented a classified list of the European Jurassic turtles. The two genera *Craspedochelys* and *Plesiochelys* are assigned to the Pleurodira, the genera *Platychelys*, *Idiochelys*, *Hydropelta*, *Chelonides*, *Parachelys*, *Eurysternum*, *Thalassemys*, and *Tropidemys* to the Cryptodira. As to the first two genera, their arrangement with the Pleurodires appears to the present writer as extremely doubtful. At present the only reasons for not placing them definitely among the Amphichelydia are found in the absence of the mesoplastra and the apparent union of the pubis with the xiphiplastron. It is, however, not at all improbable that there were Amphichelydia which had renounced the mesoplastral bones. With the exception of the absence of these bones, the shell resembles greatly that of *Baëna*. Only the pubis was attached to the xiphiplastron, but even in the Amphichelydia a beginning may have been made toward effecting that union which is so conspicuous in the Pleurodires. The skull of *Plesiochelys* is not certainly known. Rütimeyer has identified with doubt as belonging to this genus a skull which is now in the museum at Solothurn (Rütimeyer, 1873, pp. 98, 183, pl. xiv, figs. 1, 2). Thanks to the liberality of Dr. J. Bloch, now in charge of the collections, I have been permitted to study this skull and the other splendid chelonian materials there. I conclude that there is little about this skull to suggest pleurodiran affinities, as Dr. Rütimeyer himself states. Rütimeyer has indeed represented a suture running from near the fore end of the basisphenoid outward and backward toward the articulation of the lower jaw. If this suture were really present, it would limit the pterygoid posteriorly and permit the basisphenoid to come into contact with the quadrate, a true pleurodiran character; but the writer could not find this suture. If this skull belongs to *Plesiochelys*, as seems probable, this genus belonged to either the Cryptodira or the Amphichelydia. It could be placed among the former only in case future discoveries should demonstrate the presence of ginglymoid articulations in the hinder cervicals.

It appears much more probable that *Chelonides* (name preoccupied, for which **Anaphotidemys** is proposed) is a Pleurodire. If we can rely on Portis's figure (Portis, 1878, pl. xvii, fig. 12) the basisphenoid must have extended behind the pterygoids to the quadrate, and this condition is found only in the Pleurodires. Those who have access to this specimen ought to examine it carefully with reference to this suture.

Dr. Fraas refers *Platychelys* to the Chelydridæ. Now, this genus possesses well-developed mesoplastra, a condition which at once shuts it out of the Chelydridæ, and, according to our present knowledge, out of the Cryptodira. There can be no doubt that Mr. Lydekker was right when he placed this genus among the Amphichelydia. The characters which it possesses in common with the Chelydridæ are those which it and the latter have inherited from common ancestors, of the Mesozoic or Permian. Rütimeyer (1873, p. 183, pl. xiv, fig. 5) has represented a skull, belonging to the museum at Solothurn, which he refers with doubt to *Thalassemys*. This skull closely resembles that of *Baëna*, and the writer believes that it probably belongs to *Platychelys*. It differs from that of *Baëna* especially in having the frontals enter largely into the rim of the orbit. The writer is convinced that nasal bones are present, having been overlooked by Rütimeyer. Likewise, the suture separating the quadratojugal from the jugal has not been represented. It ought to begin in the drawing just above and in front of the figure 27 and run upward and backward to end apparently below and in front of the figure 8. It is to be noted that this skull is completely roofed over in the temporal region. The supraoccipital spine is broken off posteriorly, but it appears to have been short, as in *Baëna*. The mandibular symphysis is about 12 mm. long.

The writer does not see why *Idiochelys* and *Hydropelta* should not be included among the Thalassemydidæ. If they form a separate family, this must receive the name Idiochelyidæ; for the name "Halmyrachelydæ" violates all modern codes of nomenclature, there being no such genus as *Halmyrachelys*.

Mr. Lydekker assigns *Idiochelys* to the Pleurodira, referring for support to the flexure of the neck, and, as did Rütimeyer, to the transverse processes of the cervicals. The flexure of the neck in these primitive turtles, as shown in the specimens, can indicate nothing with certainty. The ginglymoid articulations of the posterior cervicals, and the other structures controlling the bending of the neck would probably be only feebly developed. The transverse processes might well be yet retained in these primitive Cryptodira. According to the writer's view, the fontanelles found in the carapace and the plastron are indications of its position among the Cryptodira; for, so far as we know them, both the Amphichelydia and the Pleurodira possess well-developed shells. Our knowledge of the skull of *Idiochelys* leaves something to be desired. We know little regarding the structure of the palate and the base of the skull, and no details regarding the cervical vertebræ. The sutures of the skull, as shown in Lortet's figures (Lortet, 1892, pl. ix, fig. 1) are surprisingly distinct and awake the suspicion, perhaps unjust, that they are the sulci which limited the horny shields. Such shields are present in the Chelydridæ (Boulenger, 1889, p. 24, fig. 5) and likewise in *Baëna* (Hay, 1904, p. 264, pl. xii, fig. 1); although indistinct in the species figured in the present paper. The upper surface of an undescribed and undetermined species of Jurassic turtle in the museum at Solothurn shows distinctly the presence of horny scutes. This appears to have been the original condition of the chelonian skull, and has been inherited by the species of the genus *Chelonia* and some other turtles.

An examination of the figures of *Idiochelys* presented by Rütimeyer and Lortet shows that the neck has been shorter even than in *Baëna*, apparently considerably less than one-half the length of the dorsal portion of the vertebral column. The same condition is displayed by the figure of *Acichelys wagleri*. These add to the evidence that the primitive turtles had very short necks: and we may conclude that *Dermochelys* and the Cheloniidæ have inherited, and not secondarily acquired, their short necks.

A study of the published figures of *Idiochelys*, *Acichelys*, *Plesiochelys*, and other Jurassic turtles, shows that in these primitive forms the nuchal bone was relatively much shorter than in modern forms. That of *Idiochelys* is contained in the length of the carapace 8.5 times; that of *Acichelys*, 13 times; that of *Plesiochelys*, 9 times. In the case of a Bridger species of *Baëna* the length of the nuchal enters the length of the carapace 9 times; in *Compsemys plicatula*, 7.5 times. In *Dermochelys* and the Cheloniidæ the nuchal is short, in *Thalassochelys* about one-eighth of the length of the carapace. As the length of the neck increased and use began to be made of the shell as a protection for the head, the nuchal and the anterior peripherals lengthened to form a projecting roof. In many Emydidæ the nuchal forms from a seventh to a fifth of the length of the upper shell, or even more. In *Hydromedusa* the nuchal forms a fourth of the length of the carapace.

The writer grants as a conclusion probably true that reached by Dr. Fraas (1903, p. 96) that the Thalassemydidæ did not give origin to the land and swamp turtles. Such forms as the Emydidæ probably sprang from Amphichelydia which had retained the completely developed shell, with the plastron suturally united with the carapace. And yet there appears to be no conclusive reason why even Emydidæ might not have had Thalassemydidæ for their ancestors. Are we to suppose that if a group of turtles has had the shell reduced as much as it is in the Cheloniidæ, with the plastron free from the carapace, to adapt the animal to a certain environment, under no conditions can a completely developed shell be recovered? According to such a doctrine, no impairment in the development of an organ under unfavorable conditions could be made good under improved conditions.

Dr. Fraas (1903, p. 96) expresses the conviction that the Thalassemydidæ represent forms of fresh-water turtles which had become adapted to marine life; and as expressing still more distinctly his meaning he says, "Ich gebe zu und nehme auch an, dass die Thalassemyden die Küste gelegentlich aufsuchten, insbesondere zum Ablegen der Eier." Now, there are no living turtles to which such language can be applied, except *Dermochelys* and the Cheloniidæ. Were the Thalassemydidæ aquatic and marine to any such degree? The writer does not believe that they were. There is not the slightest evidence that they ever left the coast for any considerable distance. They were aquatic perhaps to about the degree that the Chelydridæ are aquatic. Rütimeyer is nearer the truth when he expresses the opinion (1873, p. 171) that the great majority of these fossil turtles did not inhabit the open sea, but the littoral or estuaries and large rivers. An examination of the figures of *Acichelys* (*Eurysternum*) and *Idiochelys* presented by Zittel (1877, pls. xxvii, xxviii) and Lortet (1892, pl. i) demonstrate that the limbs, especially the feet, of these turtles were greatly like those of our more aquatic Emyds; in fact, they were rather feebly developed. The fore and hind limbs were about equally developed, and they had about the same ratio to the length of the shell that they have in *Malacoclemmys geographica*, one of the most aquatic of the North American Emydidæ. The bones of the limbs of *Acichelys* are, however, more stoutly built than those of *Malacoclemmys*, and the fifth finger is longer and has one more phalange; so that it may have been a somewhat bolder swimmer. On the other hand, it may have been accustomed to more vigorous walking, as *Chelydra*. The foot of *Acichelys* is not so much modified for swimming as that of the Trionychidæ. It is not unlikely that the genus under discussion haunted the sea-shores and captured marine prey, much as do our North American salt-water terrapins of the genus *Malacoclemmys*. That such were the habits of these extinct forms is indicated as probable by the occurrence of two species of *Thalassemys* at Solothurn, where are found four species of *Plesiochelys*. Dr. Fraas says that the latter betray themselves by their thick, massive shells as land forms. Three species of *Tropidemys* occur at Solothurn, and these too possess thick heavy shells, and could hardly have been free swimmers in the sea.

In discussing the relationships of the Thalassemydidæ to the Cheloniidæ, Dr. Fraas says that he will not assert that the former were the direct ancestors of the latter, but he holds it as certain that the Thalassemydidæ introduced the course of evolution which led to the Cheloniidæ. He supports his view by arguments drawn from various structures, but the reduced condition of the shell is especially taken to indicate an adaptation to aquatic life, especially to marine life. We shall then consider the question whether and to what extent reduction of the shell and the freeing of the plastron from the carapace betoken aquatic, and especially marine, habits.

In some of the species of Testudo the shell is thick, especially along the free borders, where a carnivorous animal might fix his jaws; and in some of the species the skin of the legs is furnished with a mosaic of bony plates and nodules, each of which is further strengthened by a layer of horn. When the animal withdraws within the shell these armored legs close all the openings. On the other hand, at least one species of the genus, which inhabited the Galapagos Islands, had a shell of papery thinness, and perforated with holes. There is no probability that aquatic life had anything to do with the reduction of the shell of the latter. In *Terrapene*, a genus almost exclusively terrestrial, the plastron is connected with the carapace by ligaments. On the other hand, many species of Emydidæ spend almost the whole of their lives in the water, and yet they have complete and heavy shells; indeed it is probable that in some cases the shell is thickened for the purpose of increasing the specific gravity of the animal. *Chelydra serpentina* is probably no more aquatic than many of the species of *Chrysemys*, and is accustomed to making marches over land from one body of water to another; yet the shell is as much reduced as that of the Cheloniidæ, which leave the water only to deposit their eggs. The explanation here is probably that the snapper is a vigorous, strong-limbed brute who is ready to use his jaws, and therefore needs less a defensive armor. *Dermochelys* has probably had the advantage of more geological ages in which to get rid of his armor than have the Cheloniidæ; and being a powerful swimmer, getting his sustenance from the surface, he has less need for a strong heavy shell than do the other sea-turtles who must dive to the bottom for their mollusks and sea-weeds. It is not due to the fact that the former is more aquatic than the latter. It may be doubted whether the reduction of the shell in *Protostega* and *Archelon* has reduced the specific gravity of the animal. The plastron of the former is very thick and heavy (Hay, 1895). In the case of *Archelon* (Wieland, 1903) the ribs are club-like, thick, and heavy, and the plastral bones also are thick. It seems to the writer doubtful that this was a pelagic turtle, like *Dermochelys*. That enormous hooked beak (Wieland, 1900A.), that extensive crushing surface between the beak and the choanæ, and the corresponding extensive surface of the lower jaw, together with the obsolete triturating surfaces of the hinder portions of the jaws, indicate an animal which was accustomed to snapping up and crushing various kinds of mollusks. The beak seems to be admirably adapted to the crushing of the various species of *Nautilus* and related forms which were found associated with the turtle (Wieland, 1903). To obtain such mollusks it would be necessary for the turtle to seek the bottom; and the enormous and heavy head is well fitted for holding the animal in a position favorable for picking up his food.

The points which the writer desires to make are that reduction of the shell and the loosening of the plastron do not necessarily indicate aquatic life; that life in neither fresh nor salt water always leads to reduction of the shell; and that the amount of reduction is not in proportion to the degree of devotion to aquatic life.

The family of Cheloniidæ has within some years, at the hands of various writers, been greatly expanded. Mr. Lydekker (1889B) included in it, besides the living genera, *Argillochelys* and Cope's Propleuridæ. More recently, Dr. Dollo (1903) places in the family, besides the living genera, the following: *Eosphargis*, *Protosphargis*, *Archelon*, *Protostega*, *Allopleuron*, *Toxochelys*, *Desmatochelys*, *Argillochelys*, *Lytoloma*, and *Proëretmochelys*. Dr. G. R. Wieland (1902, 1904A) does not differ essentially from Dr. Dollo, except that in the earlier publication just cited he included *Rhinochelys;* and besides arranged *Eosphargis* with *Dermochelys*. According to these writers, therefore, the family includes a great range of forms and a great variety of structure. The most ancient of the species existed near the beginning of the Upper Cretaceous.

In order to discuss intelligently what genera are to be comprehended in the Cheloniidæ, we ought first to determine what is the essential character or characters of the family.

There can be no question, I think, that in several features the modern Cheloniidæ are very primitive. In the skull we find the stapedial passage forming an open notch, whereas in the higher groups it is wholly closed or nearly so. It is closed even in the Chelydridæ. The roofing of the temporal region is certainly a primitive character. Dr. Fraas (1903, pp. 99, 100) believes that it is a character that has been acquired by the Cheloniidæ, and that even among the Thalassemydidæ it was already developed. It would be very instructive if we could have any Jurassic turtles pointed out which possessed an open temporal region. How are we to explain the slender parieto-squamosal bar of such Pleurodira as *Chelys*, *Rhinemys*, and *Hydraspis* except as the last vestiges of such a roof, which has been eaten away from below and forward? The reduction of the temporal roof in turtles has probably been correlated with the lengthening of the neck and the ability thereby acquired to retract the head within the shell and thus protect it.

The structure of the carapace and of the plastron have figured largely in determining the assignment of certain fossil genera to the Cheloniidæ. In the living genera there are likely to be persisting fontanelles between the peripheral bones and the costal plates; and there are always fontanelles in the plastron; while the carapace and the plastron are never suturally united. But, as already stated, the reduction of the carapace and plastron and the loosening of the plastro-carapacial articulations are likely to be found in the most widely separated families, in the Cheloniidæ, the Dermatemydidæ, Emydidæ, Dermochelyidæ, Chelydridæ, and Thalassemydidæ; and thus this reduction constitutes no determinative character.

Now, to the writer it appears evident that that character which, joined to the primitive characters mentioned, differentiates the Cheloniidæ from all other Thecophora is the conversion of the fore limbs into flippers, which consist of the elongated fingers bound together beneath the skin and which lack phalangeal condyles. In the living forms this limb has the claws reduced to one or two, the humerus is flattened, and the radial process brought down below the head of the humerus. Unless the family is restricted to forms having such limbs, the bars will be let down for the inclusion of the most heterogeneous materials. Almost any timid testudinate may stick to the coast and never go to sea and still be regarded as a member of the chelonian navy.

The relegation of *Eosphargis* by Dr. Dollo to the Cheloniidæ appears to be wholly unjustifiable; since we have of that genus not only a portion of the shell but the humerus and the skull. These are, as Lydekker has stated, wholly like those of *Dermochelys*, including in the skull the lack of descending parietal plates. Dr. Dollo's reason for removing the genus from the Dermochelyidæ is the absence of mosaic plates: but these appear to be represented, in part at least, by a row of larger median bones. There have probably been different styles of armor among the Athecæ, as elsewhere.

As stated, Dr. Wieland has included *Rhinochelys* among the sea-turtles. Of this Upper Cretaceous genus no part is known but the skull. It has been placed provisionally among the Pleurodira by Lydekker; but there are at least equally good reasons for including it among the Amphichelydia. The skull is certainly a very generalized one.

Osteopygis may now be considered. Dr. Wieland has described this from a fine specimen belonging to the Marsh collection at Yale University (1904A), placing it among the Propleuridæ, but later (1904B, p. 194) referring it definitely to the Cheloniidæ. Nothing is known of this genus except the shell, the humerus, the ulna, femur, tibia, and some phalanges. The humerus is stated to be intermediate between that of *Chelydra* and that of *Testudo*, but the feature recalling the last named genus is the facetted distal end, a feature of various turtles. The other limb bones are said to be comparable feature by feature with those of *Chelydra*.

If now *Osteopygis* with its chelydra-like limbs is to be allowed a place among the Cheloniidæ there appears to be no sufficient reason why the Thalassemydidæ should not be included. In these turtles we have a shell which is admitted by all to be greatly like that of our sea-turtles, the carapace and plastron having suffered various degrees of reduction, and in some at least the plastron being not sutured with the carapace. The skull is well roofed over, the symphysis of the lower jaw is as long as in *Thalassochelys* (Dollo, 1903, p. 813), and the feet were probably fully webbed. Also, the species appear to have lived in the vicinity of salt water. Mr. Lydekker (1889, p. 27) holds that there is considerable probability that our modern sea-turtles have descended from these Thalassemydidæ (Acichelyidæ of Lydekker); Dr. Dollo (1903, p. 840) speaks of the latter family as ancestral forms of the marine Thecophora; and Dr. Fraas (1903, p. 104) concludes that from the Thalassemydidæ the Cheloniidæ might have been evolved. Why, then, should those who admit *Osteopygis* and its allies to a place among the Cheloniidæ refuse to take in also the Thalassemydidæ? Hitherto it has been a want of knowledge of the feet of the "Chelonemydidæ" (Zittel, 1889, p. 528) that has prevented the association of these with the Thalassemydidæ; but now neither that lack of knowledge nor the probability that the feet were chelydra-like prevents various writers from uniting these "Chelonemydidæ" with the Cheloniidæ. The writer regards it as much better to unite the so-called Chelonemydidæ with the Thalassemydidæ as a family distinct from the Cheloniidæ. The former may have sprung from some member of the thus limited Thalassemydidæ; but that furnishes no final reason for comprehending all in one family. Otherwise we might extend the family backward into the Amphichelydia, or even into the Cotylosauria.

It may be permitted at this point to discuss the structure of the humerus of the Testudines. Dr. Wieland (1900B, p. 423) has named and endeavored to define six forms of the humerus: the parachelic, as exemplified in *Testudo;* the chelic, as presented in *Chelydra;* the chelicoid, as shown in the Thalassemydidæ; the thalassoid, as displayed in *Lytoloma;* the thalassic, the type of which is furnished by our living Cheloniidæ; and the parathalassic, as found in *Dermochelys.* After some study of the subject I believe that only three classes of testudinate humeri can be successfully defended, the chelic, the thalassic, and the parathalassic. The parachelic, chelicoid, and thalassoid humeri are only minor modifications of the chelic. It is doubtful whether a single one of the characteristics of the parachelic form suggested by Wieland will serve to distinguish it from the chelic. The shaft varies in curvature in different species, and it is doubtful whether it is ever as much curved as in *Terrapene* or in some species of Pleurodira. The radial crest of *Testudo radiata,* for example, is lower down on the shaft than it is in *Chelydra* and Trionychidæ. The ectepicondylar foramen is like that of the Emydidæ, and is certainly not higher up than in *Compsemys plicatula.* The feature most conspicuous in the humeri of the Testudos is the small angle between the radial and ulnar tuberosities, both being twisted toward the ventral side of the shaft (Lydekker, 1889, p. 3).

It is difficult to explain the so-called chelicoid form of humerus displayed by some of the Thalassemydidæ, such as the one figured by Mr. Lydekker (1889, p. 2), in which the head of the bone is feebly developed. It has been suggested that this represents the primitive form of the testudinate humerus; but this view can hardly be maintained. Not all of the family had the humeral head so feebly developed. The head appears of normal form in the figure of the humerus of the fore limb of *Acichelys wagleri* (Zittel, 1889, p. 529, fig. 497). In this specimen the ulnar crest is buried yet in the matrix. The head of the humerus has the normal development in the specimen of *A. crassipes,* figured by Dr. Lortet (1892, pl. ii, fig. 7).

The chelic form of humerus appears in the Amphichelydia, the Pleurodira, the Cryptodira, and the Trionychoidea, and must therefore be regarded as more primitive than the apparently abnormal form seen in some of the Thalassemydidæ. The humerus has the true chelic form in *Compsemys plicatula,* of the Upper Jurassic.

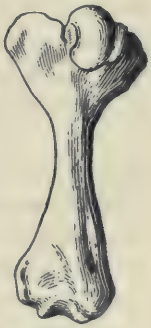

Fig. 4. *Compsemys plicatula.* Right humerus seen from above. × ¾.

Doubtless, the thalassic humerus was derived from the chelic, and there have existed transitional forms which may be described as thalassoid; but probably all known forms will fall into either the chelic or the thalassic. Dr. Dollo was very correct when he affirmed that the humerus of *Lytoloma* was essentially like that of *Chelydra*. This is given by Dr. Wieland as an example of the thalassoid humerus. As a second example, the humerus of *Toxochelys* is suggested (Wieland, 1900B, p. 418, 1902, p. 96), with the statement that this form is characteristic of the older Cheloniidæ and closely approaching typical outlines. Unfortunately, the known humeri of this genus are crushed, so that from them it cannot be definitely determined how much they were curved. Nevertheless, in the view of the writer, this humerus was wholly chelic. From that of *Chelydra* it differs in having a broader shaft, not due to crushing, and the radial process falls slightly below the head; but this process descends quite as low in *Platypeltis*, and still lower in *Hydromedusa tectifera* and especially in *Testudo radiata;* and the latter has not been supposed to be on the way to developing flippers. A humerus of *Toxochelys* in the American Museum of Natural History makes it evident that the shaft possessed a sigmoid curve, that the head rose above the shaft when the latter was held horizontally, and that the tuberosities were separated behind by a broad fossa, as in *Chelydra*.

It is proper to retain the humerus of *Dermochelys* in a distinct class. Here the radial process is extremely prominent, the attachment of the ligaments extends quite across the ventral surface of the shaft, and the ectepicondylar foramen remains within the bone. To the writer it appears probable that these peculiarities have not been developed from Thecophore ancestors, but have been elaborated by an independent line of ancestors.

Returning now to a consideration of some of the other genera which have been thrown into the family Cheloniidæ, I express it as my opinion that *Protostega*, *Archelon*, and *Protosphargis* would better be retained in a family distinct from the Cheloniidæ. It is quite evident that the modern sea-turtles did not originate from the Protostegidæ, as is shown by the greatly reduced carapace of the latter. Not from these, nor from *Osteopygis*, with its probably chelydroid limbs; but from some probably Lower Cretaceous ancestor somewhat like *Toxochelys*, but with probably still better developed flippers, arose the modern Cheloniidæ. The latter and the Protostegidæ may yet be found to constitute subfamilies of one family; but so far as known, their characters are so different, and the times of their culmination so far apart, that it seems better for the present to retain them as distinct families.

We must now consider still further the genus *Toxochelys*. It is regarded by both Dr. Dollo and Dr. Wieland as belonging to the Cheloniidæ. For my part I shall regard the limbs as furnishing a test of the correctness of this disposition of the genus. Dr. Wieland has had the opportunity of studying and describing the best yet known limb of *Toxochelys latiremis* (1902, p. 95, fig. 95). According to Dr. Wieland's description and restoration, the first and second fingers were stout and furnished with strong claws; the other fingers were slender. It seems quite possible that the third finger had a weak claw, but this is not certain. Now, while this limb presents some resemblances to the flippers of the sea-turtles, it had really not yet attained the stage represented by the fore limb of the Trionychidæ. The form of the humerus has already received attention. On page 97 of Dr. Wieland's paper just cited, he has presented a table showing the lengths of the elements of the fore limb of several genera relative to the humerus, this being taken as 100. The reader should consult this table. I here present also the measurements of the limb of *Amyda spinifera*. I add those of *Toxochelys* taken from Wieland:

	Arm.			Fingers.				
	Humerus	Radius	Ulna	1st	2nd	3d	4th	5th
Amyda.	100	53	51	69	90	98	116	98
Toxochelys.	100	58	50	51	73	100±	104±	70±

Here we see that, while there is more difference between the length of the radius and the ulna in *Toxochelys* than there is in *Amyda*, the fingers of *Amyda* are as long as, or longer than, those of *Toxochelys*. The first and second fingers of *Toxochelys* preserve yet the ratios to the humerus which they have in *Chelydra*, while in *Amyda* they are both much lengthened. Moreover, in *Toxochelys* the second finger is still a strong member, but in *Amyda* it is assuming a slenderness seen in *Thalassochelys*. Now, notwithstanding this transformation of the hand of *Amyda* for swimming, the limb must be regarded as essentially a walking leg and not a flipper. Any one who has had experience with these animals while alive knows that they can move over the ground and along the bottom of a stream with surprising rapidity. We can readily grant that the fore limb of *Toxochelys* had entered on the early stages of those modifications which resulted in the production of flippers; but almost certainly this turtle did not navigate the open seas. It probably passed the greater portion of its life in the salt water, but near the shores.

Therefore, on account of the limbs and the structure of the palate, I would exclude *Toxochelys* and *Porthochelys* from the Cheloniidæ. They are fully as near the Chelydridæ. Neither are they far from *Osteopygis* and *Lytoloma;* but probably the differences in the structure of the palates would keep them apart. Moreover, it is probable that the limbs of *Osteopygis* and *Lytoloma* were not to the same extent modified for swimming. For the writer, for the present the family Toxochelyidæ remains.

A few remarks may be made at this point on the chelonian flipper. As long as the animal habitually employed the limb for locomotion on the land or along the bottoms of streams, the phalanges would retain their condyles, the fingers preserve some degree of freedom of movement, and the humerus would retain its sigmoidal curvature, in order to bring the foot to the ground. When the turtle had once abandoned the land, except for rare visits, the fingers would become bound up together in the skin and muscles, and the condyles would gradually disappear. The humerus would straighten out so as to lift the paddle upward and give it a hold on the water to be thrust backward.

Dr. Dollo (1903, p. 823) has honored me with a notice of my essay on *Toxochelys* (Hay, 1896), and has recorded some differences of opinion. In that paper I expressed the conviction that *Toxochelys* was related both to the Cheloniidæ and to the Chelydridæ. As Dr. Dollo well understood, I did not hold that *Toxochelys* was intermediate in the line of descent. I stated distinctly that "*Toxochelys* is probably an offshoot from the line which led to the Cheloniidæ, an offshoot after the latter had disengaged itself from forms like the Chelydridæ." In this statement the relative "which" refers to "line" and not to "offshoot." The writer still maintains it as probable that the Cheloniidæ, the Chelydridæ, and the Toxochelyidæ sprang from common ancestors which lived in times geologically not long before *Toxochelys*. It is not opposed to this belief that the genus just named has some peculiarities of its own.

Dr. Dollo has mentioned the well-known fact that *Chelydra* possesses opisthocœlous caudal vertebræ, while those of *Toxochelys* are probably procœlous. It is not unlikely that too much importance has been given to this difference. Are we to suppose that the Chelydridæ separated from the other turtles sometime during Jurassic times, while yet the caudal vertebræ of all were bicœlous, and that the former group developed only opisthocœlous caudals, and the other turtles only procœlous caudals? Rather than accept this view, I would hold Baur's opinion that the opisthocœlous caudals are secondary: but it is more probable still that the procœlous vertebræ are secondary. We cannot believe that the forms of the vertebræ have remained fixed ever since they ceased to be biconvex. In the genus *Testudo* there are specific and doubtless individual variations in the forms of the cervicals. The last paragraph of Leon Vaillant's paper (Vaillant, 1881, p. 102) ought to be read in this connection.

Dr. Dollo places particular emphasis on the fact that the structure of the choanæ of *Toxochelys* is not intermediate between that of the *Chelydra* and that of *Thalassochelys*. In the latter genus the choanæ are removed backward to opposite the middle of the orbits and are bounded externally by the palatines, which join the vomer. In *Chelydra* the choanæ are far forward and are bounded externally partly by the palatines and partly by the maxillæ, which thus intervene between the palatines and the vomer. In *Toxochelys* the choanæ are far forward and are bounded externally by the palatines, which come forward to the vomer.

Dr. Dollo recognizes two types of anteriorly placed choanæ: (1) the primitive, those like the choanæ of *Chelydra;* and (2) the secondary, like those of *Dermochelys* and *Toxochelys*, in which the outer boundary is formed wholly by the palatines. Posteriorly placed choanæ are rightly regarded by Dr. Dollo as an adaptation to a conchifragous diet. In such cases the crushing surfaces of the jaws have become broadened and the choanæ have been pushed backward until the maxillary plate of the palatine has come into contact with the maxillary plate of the vomer. It is Dr. Dollo's contention that, in case a species possessing such a masticatory apparatus should afterwards betake itself to a diet of soft substances, the masticatory surfaces would become reduced and the choanæ would again move forward. They would then belong to the secondary type of anterior choanæ. But, according to Dr. Dollo, the palatine bone, having once been in contact with the vomer, would retain this connection, be carried forward, and thus come to bound outwardly the anteriorly placed choana; for "l'évolution est irréversible."

Now, we have no evidence whatever that *Dermochelys* itself was derived from any form that possessed a broad masticatory apparatus and posterior choanæ: just as little that *Toxochelys* ever came from such a form. It is not necessary to believe that the coast-inhabiting ancestors of *Dermochelys* crushed mollusks or other shell-covered animals. Even for weak-jawed animals the sea-coasts furnish a living. It is very certain that *Toxochelys* with its inefficient grinding apparatus frequented the shores of the Cretaceous seas. On the other hand, we can readily acknowledge the possibility that the ancestors of *Dermochelys* and *Toxochelys* were crushers of mollusks.

As to the relation of the palatine bone to the choana, we find in many turtles a process of this bone extending itself for some distance along the outer side of the choana. In a specimen of *Chelydra* at hand there is such a process reaching nearly half-way from the hinder border of the choana to the vomer. We could hardly regard it as wonderful that in some species it should attain even to the vomer. Furthermore, even if the ancestors of *Dermochelys* and *Toxochelys* had once possessed posteriorly placed choanæ, with union of palatines and vomer, it is difficult to understand why, if the choanæ had moved forward, the palatine bones should be dragged forward with the vomer. In fact, *Dermochelys* itself furnishes the disproof of Dr. Dollo's hypothesis; for the palatine usually does not join the vomer. He has referred to the figures of the skull furnished by three authors, which figures represent an interval between the palatines and the vomer; but Dr. Dollo is convinced that in the specimens thus represented the slender anterior process of the palatine has been broken off in the preparation of the specimens. However, an examination of materials in the British Museum showed the writer that the process had in no case been broken away, and nevertheless did not reach the vomer. Also, in the American Museum of Natural History there is a skull which displays a short space between the bones on one side and a somewhat greater interval on the other. Without doubt variations in the length of the process in question exist; but the fact that the two bones are usually not in contact is not favorable to the views of Dr. Dollo. The writer maintains that *Toxochelys* broadly considered is intermediate between the Cheloniidæ and the Chelydridæ, although it is not intermediate in all of its structures.

Since the Chelydridæ figure largely in the discussions on the origin and the classification of the turtles, a remark may be allowed here regarding an important structure. As is well known, the nuchal bone of the Chelydridæ is drawn out on each side into a long process, which reaches the end of the first costal plate. Mr. G. R. Boulenger (1889, p. 12) has suggested the possibility that the nuchal, in part at least, represents the modified ribs of the last cervical vertebra. This suggestion has been mentioned approvingly by Dr. J. F. Van Bemmelen (Bemmelen, 1896A, p. 325). Dr. Dollo also (1888, p. 267) adduces the presence of these supposed nuchal ribs as a reason why the Chelydridæ could not have been derived from the Propleuridæ. Now, if these nuchal processes were originally cervical ribs, we might rightly expect to find them present in some form in the older turtles. On the contrary, they do not appear even as conspicuous processes in the older turtles, much less as ribs. In *Compsemys plicatula* and in the species of *Baëna* there is hardly anything that can be homologized with this process. Apparently it must be looked upon as a secondary development.

It remains to discuss the relationships of *Dermochelys* to the other turtles. Since my former paper on this subject (Hay, 1898), the subject has been further considered by Dr. Dollo (1901, 1903) and Dr. Wieland (1902, p. 105).

Notwithstanding the fact that Dr. Dollo maintains that *Dermochelys* has been derived from some member of the Cheloniidæ, more specifically from *Toxochelys* (1903, p. 826), he regards it as representing one of the two primary divisions, perhaps suborders, of the turtles. These animals he divides into (1) the "Thécophores," turtles having a thecophore armor more or less reduced and no athecate armor; and (2) the "Athèques," those turtles with the thecophore armor extremely reduced, but possessing an athecate armor. Now, while this classification agrees wholly with the present writer's view, the basis of it is not satisfactory. The acquirement of a dermal armor, even by turtles, is of no such importance. Several of the living species of the genus *Testudo* are provided with an armor of bones in the skin of the legs. In some of the fossil species of the genus found in North America the legs are heavily armored, as well as the thighs and the upper surface of the tail. Other species of this genus have no such armor. Dr. Wieland is more consistent, though erring, when he makes the Dermochelyidæ one of the superfamilies of the Cryptodira.

Dr. Dollo is of the opinion that *Dermochelys*, as well as all the sea-turtles, was derived from terrestrial ancestors. He is doubtless correct in this conclusion. This ancestor, he thinks (1901, p. 4), possessed a thecophore, but not an athecate, armor. The next stage in the evolution was probably furnished by a similarly armored turtle which frequented the sea-shore, had broad crushing jaws, and probably lived on mollusks. The successor of this was a littoral turtle, represented by *Toxochelys*, which had changed his habits of life, eating now softer foods, had had the crushing jaws greatly reduced, with the choanæ moved forward, and the thecophore armor also much reduced. The next stage was a pelagic thecophore. It differed from its predecessor in having the carapace reduced to the nuchal bone, while the plastron formed only a ring, and was without an entoplastron. The next stage was a littoral athecate. The representatives of the line had returned to life along the coasts. They needed an armor of some kind, and were compelled to develop in the skin, one, consisting of a mosaic of small but thick plates. Again, through impulse or necessity, the race was driven to the open sea. Having again less use for an armor, the dermal mosaic of thick plates suffered reduction; and the living representative of the line is our leather-back turtle, which possesses a dermal armor of thin closely joined bony plates, frequents the open sea, and lives on the softest of foods.

As already stated, the reptile which Dr. Dollo has selected for the honor of representing the third stage in these transformations is *Toxochelys* (Dollo, 1903, p. 826). It is an ungracious thing to attempt to divert a distinction from an old friend. I have already given my reasons for thinking that the limbs of *Toxochelys* had not yet advanced beyond the stage seen in the Trionychidæ. It is probable that the shell was not yet reduced so much as has been supposed. The specimen that has been figured by Dr. Case (1898) was probably an immature one, and this will account for the large fontanelles. The carapace of *Porthochelys*, a close relative of *Toxochelys*, has been described by Williston (1901). In this the shell is almost wholly without fontanelles.

Eosphargis of the Lower Eocene London Clay is taken by Dr. Dollo to represent the next stage in the line of development from *Toxochelys* to *Dermochelys*. During the interval between the Niobrara and the London Clay *Toxochelys*, we are to suppose, had to get rid of its carapace, and to transform its chelic humerus into a parathalassic one, its trionychoid feet into dermocheloid flippers, and its chelydra-like head into one like that of *Dermochelys*, wholly devoid of descending parietal plates. If *Eosphargis* had no athecate armor its descendants developed this by the time of the Middle Eocene; for then *Psephophorus* appears with an armor of thick dermal plates. These are very rapid transformations for turtles to accomplish, and some of us may be excused for harboring doubts. It may be proper to call attention to the fact that the supposed reduction of the parietal plates seems to contradict Dr. Dollo's law that "l'évolution est irréversible." It will hardly be contended that the presence of the descending parietal plates is a primitive condition. Through a course of evolution they formed an articulation with the pterygoids. The writer finds it difficult to discover what explanation of the interruption of this union can be given that would not require the admission that the union of the palatines and the vomer might be abrogated in the production of the secondary type of anterior choanæ.

A second violation of the law referred to seems to be found in the condition of the basisphenoid in *Dermochelys*, if we are to accept Dr. Dollo's genealogy. This basisphenoidal region is quite differently constructed in the Dermochelyidæ and the Cheloniidæ. In the former the basisphenoid is long, and almost entirely separates the pterygoids. In this respect it is like that of *Baëna* and doubtless presents the primitive condition. In the Cheloniidæ, *Thalassochelys*, for example, the pterygoids meet along the midline for a great distance and the basisphenoid has become much shortened. Moreover, in *Dermochelys* the borders of the basisphenoid are overlapped by the pterygoids: whereas, in *Thalassochelys* the borders of the pterygoids pass beneath the basisphenoid. Now, in *Toxochelys* we have the same arrangement of the bones of this part of the skull that we have in *Thalassochelys*. Are we to suppose that in *Dermochelys* there has been a reversion to something greatly like the original condition of the base of the skull?

To some of those who admit the important structural differences that exist between the Dermochelyidæ and the Cheloniidæ the greatest obstacle in the way of accepting *Dermochelys* as the representative of a distinct suborder is the idea that it must then be regarded as the type of a structurally primitive form. So far as I am able to discover, this notion has been most strongly emphasized by the opponents of the early origin of the Athecæ. Dr. A. S. Woodward has, indeed, spoken of the Athecæ as being primitive (1887); but this admission appears to be wholly unnecessary, besides not being wholly justified by our knowledge of the animal. The present writer has already recorded (1898) his view that *Dermochelys* is not in all respects primitive. It is indeed a form highly specialized for life in the open sea. There can be no question that it has been developed from an ancestor which possessed walking limbs. We do not need to deny that the carapace has undergone great reduction, so that now the costals are obsolete and the peripherals wholly wanting and only the nuchal remains; nor that the plastron has suffered conspicuous losses. To undergo such modifications, it is not necessary to suppose that its ancestors belonged to the Cheloniidæ. If a terrestrial member of the Prochelonida (Haeckel, 1895, p. 322), back in Permian times or in the early Trias, had betaken itself to sea-faring life, we can easily imagine that its offspring would have arrived structurally where we find *Dermochelys* to-day. With such a conception of *Dermochelys* we can, without conceding Dr. Dollo's conclusion regarding its relations (1901, p. 1, par. 3), grant the greater number of his premises, especially those recorded under paragraphs 1, 3, 4, 5, pages 5–7, of the paper just cited. Where the author of that paper employs the term "Thecophore" we may substitute the word "Prochelonida." The primitive turtle from which the leather-back sprang probably possessed a more or less extensively developed system of costal plates, peripheral bones, neurals, and plastral bones, and hence was, in a structural sense, a thecophore; although other characters would have excluded it from the suborder Thecophora.

On Dr. Dollo's paragraph 2, of the paper last referred to, we may remark that the failure hitherto to find pretertiary Athecæ is no certain evidence that they did not exist. One of the attractions of the science of palæontology is the pleasure often enjoyed in discovering members of evolutionary lines in far older deposits than any yet recorded. Is not Dr. Dollo compelled to await the finding of the late Cretaceous and early Tertiary links in his *Toxochelys-Dermochelys* chain? Do we not likewise yet hope for the discovery of the predecessors of *Proganochelys?*

On Dr. Dollo's paragraph 3, the comment may be made that the plan of the plastron of *Dermochelys* and that of the other turtles is the same because the Prochelonida had the plastron built on the same general plan. It probably contained more bones than are now found in the plastron of any turtle; but similar needs have led to the retention of practically the same bones in all the groups of turtles. No doubt, the Prochelonida all possessed mesoplastra and an entoplastron; but the great majority of turtles have dispensed with the mesoplastra; *Dermochelys* and *Kinosternon* no longer possess the entoplastron; and *Dermochelys* and the Trionychidæ have lost the peripheralia. We cannot suppose that the Dermochelyidæ sprang from the Trionychoidea because both groups lack peripherals, nor from the Kinosternidæ because both families lack the entoplastron.

On paragraph 6 of Dr. Dollo's paper it may be said that as regards the loss of nails, the regression of ossification, and various points in the structure of the skull, all these modifications might have been effected in the two groups independently during descent from a common ancestor. Whether or not the primitive turtles possessed the descending plates of the parietals we cannot now be certain. At least, it must have appeared in the primitive Thecophore, for it has been transmitted to all the superfamilies, the Amphichelydia, the

Pleurodira, the Cryptodira, and the Trionychoidea. Dr. E. C. Case is inclined to believe that such plates existed in the Diadectidæ (Case, 1905, p. 140): and if this is true, it is probable that they existed also in the Prochelonida. They have then been lost during the history of the Athecæ: but the utter elimination of elements so completely removed from outside influences, apparently so useful in strengthening the skull and protecting the brain and the cephalic nerves, must, seeing how slowly changes in turtles are effected, have required an immense extent of time.

Dr. Wieland (1902, p. 97) has attempted to show, by measurements taken from *Chelydra*, *Toxochelys*, *Eretmochelys*, and *Dermochelys*, the general trend of the changes which have occurred in the testudinate flipper. In the opinion of the present writer, his results are not especially favorable to the view that the last-named genus has been derived from the Cheloniidæ. He announces that the measurements show "strongly marked radial and ulnar decrease in length." On the contrary, as compared with the radius of *Chelydra*, whose radius is .52 of the length of its humerus, an increase of length is shown in *Toxochelys* to .58; in *Archelon* to .54; in *Eretmochelys* to .53. I find in a specimen of *Thalassochelys* that the radius is .60 of the length of the humerus. Now, if *Dermochelys* is a final term in the series, we might expect to find its radius still longer relatively to the humerus. On the contrary, it is greatly shortened, being only .43 of the humeral length. As to the ulna, it has retained practically its primitive length in *Thalassochelys*, *Toxochelys*, and *Archelon*. In *Eretmochelys* it is considerably shortened, and in *Dermochelys* still more, that of the latter being .39 of the humerus, *Chelydra* being .53. Nevertheless, the ulna of *Dermochelys* is less shortened relatively to the radius than in the other genera, the difference being only .04 of the length of the humerus: whereas, in *Toxochelys* and *Thalassochelys* the difference is .08, and in *Eretmochelys* .09 of the length of the humerus. Hence, we again see a reversal of the changes which are supposed by Dr. Wieland to be going on leading up to *Dermochelys*.

The present writer remains convinced that it is in the mosaic carapace and plastron of *Dermochelys* that we find incontestable evidences that the Athecæ did not have their origin from any of the Cryptodira; but from the Prochelonida. However specialized the limbs and the jaws may be, however much reduced the costal plates and the plastral bones, this mosaic is primitive. It may, indeed, have undergone modifications and reductions. It was thicker in *Psephophorus;* in *Eosphargis* it may, or may not, have been reduced to a row of median plates. The importance of this dermal armor does not consist merely in its presence; for, as already stated above, such a dermal armor might have arisen secondarily. The significance of the armor of *Dermochelys* is found in the fact that it consists of a number of longitudinal bands of larger plates which correspond in number and position with the rows of horny scutes which must have belonged to the common ancestors of all the turtles. This proposition has already been discussed by the writer (Hay, 1898); but some further consideration of it is here required.

An examination of the dermal armor of *Dermochelys* shows that there are on the upper surface a median longitudinal band, or keel, of bony plates, and on each side of it three lateral keels, the outer one forming the corresponding margin of the body. Although in the adult the surface of the skin is smooth, in the very young the skin is broken up into areas which undoubtedly correspond with the bony plates. The median row of plates then represents the row of vertebral scutes found in most turtles: the first lateral row represents the row of costal scutes; the second lateral keel, or row of plates, occupies the position of the supramarginal scutes of *Macrochelys*, *Platychelys*, and *Proganochelys*. The third keel on each side corresponds to the marginal scutes.

On the ventral surface *Dermochelys* possesses five rows of bony plates, a median and two pairs of lateral ones. It is not certain that the median row is represented in any living turtle; but it is probable that the intergular of some genera corresponds to a portion of it. Mr. Lydekker (1889, p. 218) has described and figured portions of the plastron of *Archæochelys*, from the Wealden, which appears to have possessed a median, azygous row of horny shields. This would correspond exactly with the median plastral keel of *Dermochelys*.

The first lateral keel on the plastron of *Dermochelys* represents the paired horny scutes found on each side of the midline of nearly all turtles. The second lateral keels of *Dermochelys* correspond with the inframarginal scutes of the Cheloniidæ. Dr. Fraas (1903, p. 98) states that the development of inframarginals in the Thalassemydidæ is surprising, inasmuch as thereby the condition of the shell gains a pronounced *Chelonia*-like character. There can, however, be no doubt that the possession of inframarginals is a primitive, not a secondary, character. They are present probably in all of the Amphichelydia, being greatly developed in *Pleurosternon*, *Compsemys plicatula*, and in *Plesiochelys*. They are present in the Dermatemydidæ and in *Kinosternon*. The Emydidæ have retained only the ends of the series as axillary and inguinal scutes. The inframarginals appear to be wanting in the Pleurodira. Being primitive structures, it is not strange that they appear in *Thalassemys*. We may confidently expect to find them in *Proganochelys*.

In the paper by the present writer (Hay, 1898), he has called attention to the carinæ, or keels, sometimes tuberculated, which are found on the shells of various turtles. Conspicuous among these are the Chelydridæ, in which the areas of nearly all the carapacial scutes are raised into bosses. *Platychelys*, of the European Jurassic, presents another example; and it may be here remarked that, although it belongs to the Amphichelydia, it is not incredible that our Chelydridæ have descended from it. When these keels and rows of bosses are present they occupy positions corresponding to some of the keels of *Dermochelys*.

The writer has further formulated the hypothesis that each scute of the primitive turtles was supported by a distinct bone, as it is in the young of *Dermochelys*. Some of these bones with their scutes expanded at the expense of their neighbors. Among the Thecophora a time came when the bones underwent reduction, but the scutes of some of them remained and became such as we find to-day on the most of our turtles. In that paper the fact was mentioned that in a specimen of *Toxochelys* there were found along the middle of the back, at the rear border of each horny scute, a distinct bone, which was articulated to the underlying neurals. In the collection of vertebrate fossils at the University of Kansas is found another specimen which furnishes nearly the whole median line of the carapace; and here we see a series of these median bones. What can be the significance of this row of bones if it be not that they are remains of an old superficial armor like that of *Dermochelys?* Dr. Fraas (1903, p. 110) has concluded that the supramarginals of *Proganochelys* represent a series of bony plates which lay upon the ends of the ribs. I do not understand from Dr. Fraas's description of this turtle that he actually found such bones; but I have no doubt that his explanation is the correct one.

How are we to explain the coincidences above noted? How happened it that when there are so many rows of enlarged plates in *Dermochelys* this number should agree with the typical number of rows of scutes in other turtles? Is it an accident that in both cases there is a median row above and below, whereas, there might have been in one case or the other only paired rows? If *Dermochelys* originated from some of the Cheloniidæ, its ancestor had, in all probability, lost at least all traces of the supramarginals and all of the azygous plastral scutes: and yet in the offspring of these turtles there reappear a complete series of both.

All the phenomena involving the relationships of the Athecæ and the Thecophora are easily explained on the supposition that they diverged from each other far back in Triassic or Permian times; that somewhat later the Cheloniidæ arose; and that the latter and the Athecæ have ever since pursued parallel lines of development.

On the following page there is given a phylogenetic table which is intended to exhibit the writer's views on the origin and relationship of the various families, superfamilies, and the suborders of turtles.

It may be allowable to indulge in some reflections on the structure and appearance of one of the Prochelonida, the common ancestor of the Athecæ and the Thecophora. We must suppose that it lived during Permian times. The form of the skull was probably not greatly different from that of *Chelydra* or *Thalassochelys*. The temporal region was extensively roofed over; the supraoccipital was short. Even at that stage there were probably no teeth, and the jaws, as now, were covered with horn, or there may have been feeble teeth in the hinder portions of the maxilla and dentaries. The surface of the head was doubtless invested with horny scutes, some of considerable size. The quadrate bone was feebly notched behind for the passage of the stapedial rod. There were well developed nasal bones and lachrymals. The choanæ were probably well forward. There were posterior palatine foramina. The transverse bone had doubtless already disappeared. The palatines did not reach to the vomers in front of the choanæ, and these bones were separated by the body of the vomer. Doubtless the pterygoids extended backward so far as to exclude the basisphenoid and basioccipital from contact with the quadrate. The vacuity between the pterygoids and the basisphenoid had been partially or wholly closed. It seems probable that the basisphenoid did not come into contact with the vomer, thus permitting the pterygoids to meet anteriorly in the midline.

The neck was short. The vertebræ were eight in number, biconcave, furnished with transverse processes, and possibly with rudimentary ribs.

The trunk of the animal was, as now, short and broad. There were ten ribs in the trunk but the first and last were already reduced in size. There were, overlying the ribs and probably in adult life consolidated with them, a series of eight bony plates, such as existed in the Otocœlidæ and the Diadectidæ, and which did not overlap, but

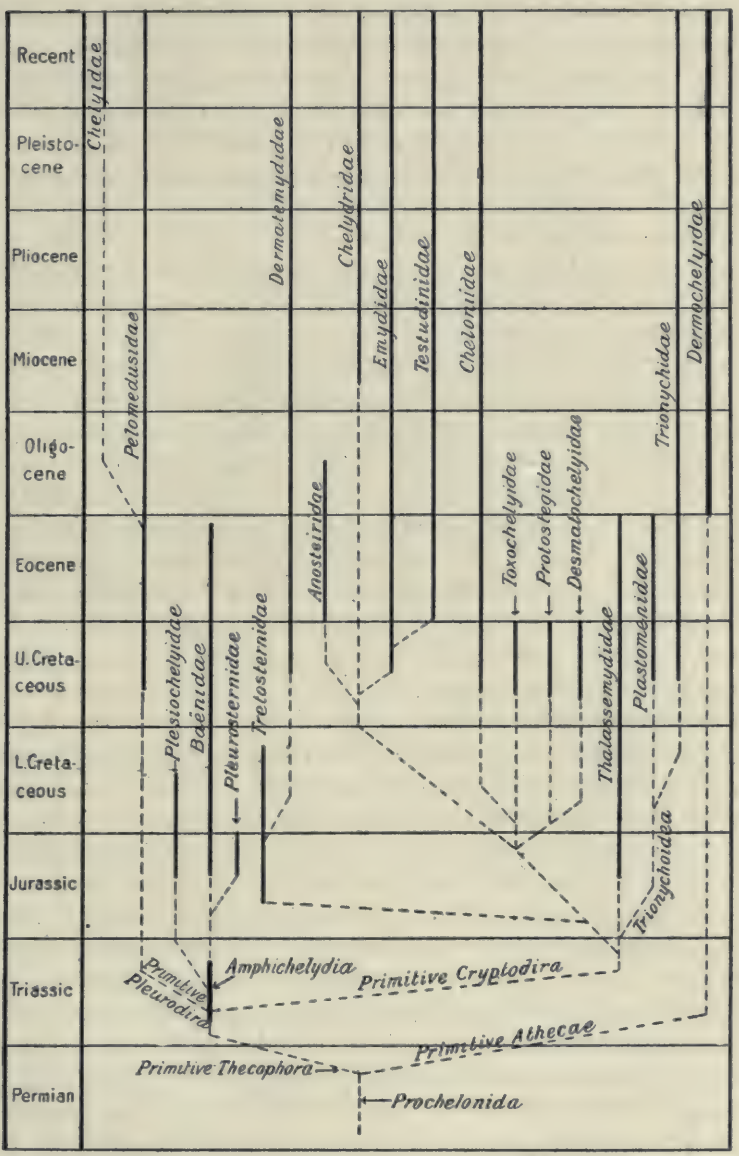
Recent
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
U. Cretaceous
L. Cretaceous
Jurassic
Triassic
Permian
Chelyidae
Pelomedusidae
Dermatemydidae
Chelydridae
Emydidae
Testudinidae
Cheloniidae
Trionychidae
Dermochelyidae
Anosteiridae
Toxochelyidae
Protostegidae
Desmatochelyidae
Plesiochelyidae
Baënidae
Pleurosternidae
Tretosternidae
Thalassemydidae
Plastomenidae
Trionychoidea
Amphichelydia
Primitive Cryptodira
Primitive Pleurodira
Primitive Athecae
Primitive Thecophora
Prochelonida

Fig. 5. Phylogenetic Chart showing supposed origin of the suborders, superfamilies, and families of turtles.

joined each other edge to edge, at least at their proximal ends. There were probably a series of median plates, corresponding to the neurals, and another series surrounding the margins of the animal, the peripherals. All these costal plates, these neurals, and peripherals lay beneath the skin. In this skin there were, above, seven longitudinal rows of dermal bones corresponding to those of *Dermochelys*. The spaces between these rows were then probably not occupied by bony plates. Where these bony plates existed they were overlaid by corresponding horny scutes.

The tail was long and thick and furnished below with chevron bones. Along the upper surface was a row of bony nodules, such as are found to-day in *Chelydra*.

The plastron of this animal doubtless possessed, besides the bones found in the Emydidæ, also mesoplastrals. From *Polysternon* it becomes probable that there was also a pair of bones between the hypoplastrals and the xiphiplastrals. At that stage there were, it would seem, extensive fontanelles between the bones of the plastron; and we are hardly compelled to believe that the carapace and plastron were suturally united. All the plastral bones were subdermal, like the abdominal splints of crocodiles. In the skin covering these bones were five longitudinal rows of bony plates, as in *Dermochelys*. The caymans possess bony plates similarly lodged in the skin, superficial to the bony abdominal splints.

As to the shoulder girdle, it is practically the same in all known turtles, and we may conclude that it was similar in the primitive stock. Possibly the precoracoidal process had not yet become so thoroughly consolidated with the scapula as in the known forms of turtles.

While we must regard the primitive turtles as terrestrial, we do not need to suppose that they were such in the sense that the Testudinidæ are terrestrial. Their feet were not constructed for marching over dry rocky plains. The animals were rather denizens of low, perhaps swampy, grounds. The limbs of all the early turtles of which we have knowledge indicate this. In general form and structure the primitive turtle limbs were probably like those of *Chelydra*. The digital formula for all the limbs was doubtless 2, 3, 3, 3, 3. Any deviation from this shown in either fossil or living species has been due to later specializations. It is not improbable that the tarsus possessed three distinct bones in the first row, as well as a centrale.

Of the offspring of the animals thus constituted, some, with need for a strong and unyielding armor, developed more completely the subdermal bones, that is, the costals, the neurals, the peripherals, and the plastrals. These, if not already in contact, extended their borders and formed sutural unions. As this thecophore skeleton evolved, the overlying skin became thinner, the dermal bones underwent reduction, and some of the horny areas extended themselves at the expense of their neighbors, resulting in the production of the large scutes which break joints with the bones of the thecophore armor. In most of the Thecophora thus produced all traces were lost of the dermal bones, but they were sparingly preserved in a few, as *Toxochelys;* just as to-day we find in *Macrochelys* vestiges of the supramarginals.

Other offspring of the Prochelonida had need for an armor that was more flexible. In these the thecophore skeleton of subdermal bones underwent gradual absorption, so that to-day, in *Dermochelys*, there are only traces of it in the carapace and, on the abdomen, in the ring of plastral bones. On the other hand, the skin thickened and the bands of dermal bones spread until there was a complete athecate armor on both the back and the abdomen. Probably from the first these individuals were the more aquatic and soon betook themselves to the sea. Their limbs then began that series of transformations the result of which we see in *Dermochelys*.

Sometime during the Triassic or early Jurassic the Amphichelydia gave off two vigorous branches, the Pleurodira and the Cryptodira; and not long thereafter the Cryptodira sent off the Trionychoidea. That the latter did not spring from the Pleurodira is manifest. The latter appear never to have had a tendency to become modified for a purely aquatic life. Even the species of *Podocnemis* that swarm in the rivers of South America show no tendency toward a modification of the limbs into flippers. Neither is there in the Pleurodira any pronounced tendency toward a reduction of the shell. Although the pterygoids of the Trionychoidea are broadened somewhat as in the Pleurodira, they have, instead of withdrawing from between the axial bones of the skull and the quadrates, extended themselves still farther backward than in the Cryptodira. The long supraoccipital is more cryptodiran than pleurodiran. The pelvis shows no leanings toward that of the Pleurodires. Whether or not the mode of flexure of the neck indicates relationships is somewhat doubtful. The most natural mode of forming permanent curvatures in the neck is that shown in the Cryptodira, and might have been developed independently in different groups. This, however, is to be said: in the Trionychoidea the neck is never flexed laterally in order to conceal the head.

In the author's opinion, there is no sufficient reason for regarding the Trionychoidea as the primitive Thecophora, as Prof. E. Haeckel has done (Haeckel, 1895, pp. 323, 328). In order to accept Haeckel's opinion, we must conclude either that the original Trionychoidea were so different from what they now are that they were not at all Trionychoidea, or that the course of evolution in the turtles has been just the opposite of what is generally held. For example, either the primitive soft-shells possessed mesoplastra and a pair of bones between the hypoplastra and the xiphiplastra, or these bones developed in some of the turtles which sprang from the Trionychoidea. The latter either possessed horny scutes or these developed later on the delicate skin of the shell of these animals. The peripheral bones must have appeared among the other turtles after they departed from the parent Trionychids. Furthermore, the limbs of the early Trionychids must have been typical walking feet, like those of *Chelydra;* and strange transformations must have affected the entoplastron. We must rather believe that the Trionychoidea originated from some aquatically inclined Cryptodira, possibly from some of the earlier Thalassemydidæ, and suffered still further reductions in the carapace and plastron. Very early they must have assumed their present structure; for *Aspideretes beecheri* (Hay, 1904, p. 274, pl. xvi) of the Laramie, and probably also of the Judith River Cretaceous, is in all known respects like a modern *Amyda.* Practically the whole skeleton of this species, except the skull, is known.

The Pleurodira deviated from the Amphichelydia especially in skull structure and in the pelvis, but likewise in neck structure and in the shell. The pterygoids have become shortened posteriorly, but broadened and uprolled at the anterior borders. There has been a strong tendency toward a reduction of the temporal roof. The neck has developed in an extraordinary way. The limbs appear in no cases to have become transformed into flippers. The mesoplastra have persisted in many genera. The sutural articulation of the pelvis with the shell is one of the characteristic features of the group. There may have been the beginnings of these attachments in the Amphichelydia; but the apparent articulation of the pubis alone will hardly serve to settle decisively the position of any particular genus. Another structure to which the Pleurodira have clung tenaciously is the intergular. So general is the presence of this scute, or scutes, in the superfamily that many cryptodire genera have been referred to the Pleurodira on this character alone.

The Cryptodira have proved to be the most expansive group of turtles. There have been evolved forms adapted to amphibious life, some for habitation in fresh waters, others for life on dry plains and rocky islands, others for life on the high seas. No form yet discovered was intended for aërial flight. Although the Cryptodira have preserved the general plan of the amphichelydian skull, they present in it a range of modifications unequalled in any of the other superfamilies. Usually the temporal roof is greatly reduced, but in some cases retained intact. In no living species are there nasals. The jaws are variously modified for the preparation of the most different kinds of food. There is also a great range in the modifications which the shell has suffered. The hinge in the plastron of *Emys* and *Terrapene;* the hinges between the plastron and carapace in *Terrapene* and *Ptychogaster;* and that between two portions of the carapace of *Kinyxis* are illustrations of these modifications. Perhaps the most specialized shell among all turtles is found in the genus *Testudo*, with its wedge-shaped costals, its variously shaped neurals, and its plastron posteriorly notched, anteriorly beaked. In this genus, as already stated, several species possess a dermal armor on the limbs, the jaws are modified for a vegetable diet, and the stapedial notch is closed. Taken altogether, it appears to the writer that the Cryptodira rank higher than the Pleurodira; although the contrary opinion is usually held.

The writer wishes to notice briefly a paper published recently by Dr. Carl Rabl, under the title "Ueber einige Probleme der Morphologie" (Rabl, 1903). In this paper Rabl discusses particularly the structure of the carpus and tarsus and that of the temporal region of the skull. His conclusions, reached after a study of the ontogenetic development of the carpus and tarsus of various reptiles, are (1) that the turtles are the most primitive among reptiles; (2) that among the chelonians the sea-turtles, including *Dermochelys*, take the lowest position; (3) that the turtles are to be divided into two groups, the "Eretmopoden," embracing the Cheloniidæ and the Dermochelyidæ, and the "Dromopoden," embracing all the other turtles; and (4) that the former group has given origin to the latter.

The ground for this primary division of the order is found in the different disposition of the second carpale and second tarsale in the two groups. In the "Eretmopoden" these bones preserve the primitive relationships, being in contact with both the first and the second metacarpals and metatarsals respectively; while in the "Dromopoden" the second carpale and second tarsale are in contact with only the second metacarpal and metatarsal respectively.

Whatever may be said regarding the propriety of splitting the order of turtles into suborders on a single, not well-understood, character, it may be remarked that Rabl's conclusions contravene the results of modern inquiry. Leaving out of the account *Dermochelys*, the order is recognized as comprising three groups, the Cryptodira, the Pleurodira, and the Trionychoidea, and this grouping is based on many important structural characters. The Cheloniidæ are recognized as being truly Cryptodira; but Rabl's arrangement would make the Trionychidæ and the Pleurodira more closely related to such forms as *Chelydra*, for example, than are the sea-turtles.

Rabl's belief that the land and swamp turtles have been derived from the sea-turtles involves the necessity of supposing that the great flippers of some ancient marine forms have become enormously modified, that the fingers have become shortened, once more freed from their common envelope of skin and muscles, have recovered the lost claws, and more especially that the humerus has become restored, in such forms as *Chelydra* and *Amyda*, for illustration, to something like the primitive condition. For the proposition that the humerus of the sea-turtles represents the primitive form of this bone is one that can hardly be successfully maintained.

Dr. Rabl finds in the structure of the temporal region of turtles support for his views on the division of these reptiles into two groups, and on the origin of all the others from the sea-turtles. In their possession of a complete temporal roof the latter prove themselves to occupy the lowest position among turtles. But Rabl has not taken into account the fossil forms. *Baëna* and its allies possess the temporal roof fully developed, but they are far from belonging to the "Eretmopoden."

Dr. Rabl emphasizes his conclusion that the temporal arch of the turtles has not resulted from the expansion of persistent fontanelles, but through the deepening of an incision, or excavation, in the occipital border of the temporal roof. This explanation serves well for the condition found in the Cryptodira and the Trionychoidea; but does not explain the presence of a parieto-squamosal arch in such Pleurodira as *Rhinemys*, *Hydraspis*, *Emydura*, and *Elysia*. Evidently in these cases the bone has been eaten away from below in a direction upward and backward.

The forms assumed by the temporal roof were fully explained long ago by Dr. George Baur (Baur, 1889, p. 472).

At the conclusion of this paper, which has already taken a wider range than was originally intended, I may be allowed to make some further remarks on Dr. Fraas's description of *Proganochelys quenstedtii.*

If I have made no error in counting, Dr. Fraas has mapped off in his restoration of this turtle (Fraas, 1899, p. 409, fig. 1) twenty-two marginal scutes on each side. As this is about double the number usually found in turtles, it seems evident that there is some error. It appears probable that alternate ones of these lines ought to represent the sutures between the peripheral bones.

The hinder peripheral bones of this turtle are extraordinarily drawn out into lobes. It is to be suspected, however, that really two of these lobes belong to a single peripheral, each of these bones being not only separated from its neighbors by a notch, but also notched in the middle of its border. Dr. Fraas thinks that we must suppose that these lobes were imbedded in a dense mass of connective tissue. The present writer sees no necessity for such a supposition. The hinder border of various turtles is notched, although not so deeply as in *Proganochelys;* and yet they are covered with horn as elsewhere.

The inference made by Dr. Fraas that the pelvis of this genus was articulated to the plastron is, I believe, not justified; neither is the conclusion that the ilium was grown fast to the carapace. The plastral attachments, of course, could not be observed, because the xiphiplastrals were not preserved. What is observed in the case of the carapace is that there is an elevation where the ilium came into contact with it; but such a structure is often seen in Cryptodira.

In his excellent description of this interesting turtle, Dr. Fraas has, the writer fears, fallen into another error. On pages 417–419 are figures and a description of the dorsal vertebræ. The first dorsal is represented as possessing on each side a long process, which Dr. Fraas regards as a diapophysis. The rib which articulates with the first and second centra is described as the first, and the succeeding ribs are numbered accordingly. Now, an examination of a modern turtle shows that the rib which articulates between the first and second dorsal centra is the second rib, that which is consolidated with the first costal plate; and where there is a sternal chamber, this rib runs out, as a ridge, on the lower side of the costal. The first rib is usually greatly reduced; starts from the first dorsal centrum exactly where the supposed diapophysis starts, and is applied to the lower side of the first costal plate, usually against the border of the second rib. There can be no doubt whatever that the supposed diapophysis is really the first rib; nor that the succeeding ribs should each have its number increased by one. As already stated, the writer believes that *Proganochelys* is not a Pleurodire, but an Amphichelydian.

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Article X. — A REVISION OF THE SPECIES OF THE FAMILY OF FOSSIL TURTLES CALLED TOXOCHELYIDÆ, WITH DESCRIPTIONS OF TWO NEW SPECIES OF *TOXOCHELYS* AND A NEW SPECIES OF *PORTHOCHELYS*.

By Oliver P. Hay.

In the present paper the author proposes to present briefly some of the results of his studies on the species of Toxochelyidæ, reserving more complete descriptions, illustrations, and conclusions for his forthcoming monograph on the fossil turtles of North America. This preliminary paper is published with the consent of the Carnegie Institution of Washington, to which the writer is indebted for aid in its preparation.

Toxochelys latiremis *Cope.*

This is the type species of the genus *Toxochelys.* The type specimen is the property of the American Museum of Natural History. This type consists of the greater portion of the lower jaw and the coracoid bone of a large specimen. Its number in the Museum's catalogue is 2362. The species was described and illustrated by Professor Cope in his work, 'The Vertebrata of the Cretaceous Formations of the West,' 1875, p. 98, pl. viii, figs. 1, 2. The American Museum possesses also the skulls of this species which were described by Professor Cope in the 'Proceedings of the American Philosophical Society,' volume XVII, p. 176.

Toxochelys brachyrhinus *Case.*

Dr. E. C. Case described this species in 1898 (Univ. Geol. Surv. Kansas, IV, p. 378, pl. lxxxiv, figs. 1, 2). His description was very brief. The blunter snout and the more nearly parallel lateral outlines of the skull are regarded by him as distinguishing this species from *T. latiremis.*

Through the courtesy of Dr. C. E. McClung, in charge of the palæontological collection of the University of Kansas, I have been permitted to study the types of this species, as well as the other fine chelonian materials in that institution.

The skull of *T. brachyrhinus* is narrower posteriorly in proportion to the length than is that of *T. latiremis*, the width at the quadrates being only eight-tenths of the length from the snout to the occipital condyle; whereas, in *T. latiremis* the width is nine-tenths of the length.

The constricted portion of the pterygoid region is narrower than it is in *T. latiremis.* In the type this measures 20 mm., the length of the skull to the occipital condyle being 117 mm. In a skull of *T. latiremis*, whose length is 130 mm., the region in question is 36 mm. wide. The interorbital space of *T. brachyrhinus* also is narrower than in *T. latiremis*, being in the type only 19 mm.; whereas, in the specimen of *T. latiremis* just mentioned this space is 24 mm. wide.

Toxochelys serrifer *Cope.*

The type of this species forms number 1835 of the American Museum of Natural History. It was collected in the Niobrara deposits of Kansas, by Professor Merrill of Topeka, in the year 1865, as shown by Professor Cope's label. The exact locality is not stated. The species was published by Cope in his 'Vertebrata of the Cretaceous Formations,' etc., p. 299, but no illustrations were furnished.

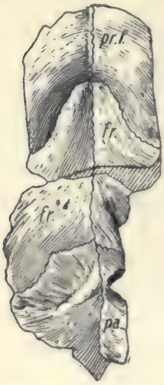

Fig. 1. *Toxochelys serrifer* Cope. Type. × 1. Portion of skull seen from above. *fr.*, frontal; *pa.*, parietal; *pr.f.*, prefrontal.

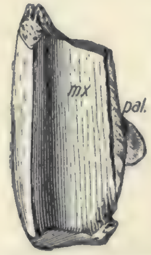

Fig. 2. *Toxochelys serrifer* Cope. Type. × 1. Seen from below. *mx.*, maxilla; *pal.* palatine.

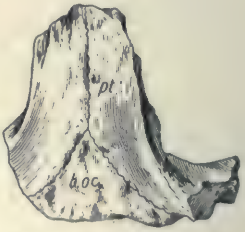

Fig. 3. *Toxochelys serrifer* Cope. Type. × 1. Base of skull. *b.oc.*, basi occipital; *pt.*, pterygoid.

The type consists of portions of the skull, the left half of the lower jaw, and two peripherals. Drawings of most of these parts are here presented, all of the natural size.

Figure 1 represents a portion of the upper surface of the skull. The anterior ends of the prefrontals, partly forming the boundary of the nasal aperture and partly joining the ascending processes of the maxillæ, have been crumbled away. The interorbital space has been 17 mm. wide. The frontals have entered widely into the orbits.

Figure 2 represents the hinder portion of the maxilla, seen from the palatal surface. On the right of the figure appears a portion of the palatine. The triturating surface of the maxilla is smooth and flat. The cutting border descends somewhat below the level of the triturating surface.

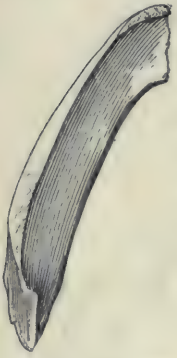

Fig. 4. *Toxocheiys serrifer* Cope. Type. × 1. Left dentary from above.

Figure 3 presents a view of the base of the skull: that is, of the greater portion of the pterygoids and the basisphenoid. The constricted portion of the pterygoid region has a width of 15 mm. The quadrate, not here figured, has an unusually small articular surface for the lower jaw. Posteriorly there is a sharp and deep notch for the passage of the stapedial rod.

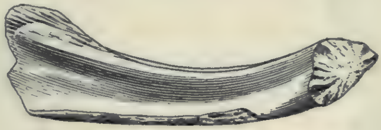

Fig. 5. *Toxochelys serrifer* Cope. Type. × 1. Left dentary from inner side.

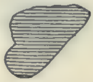

Fig. 6. *Toxochelys serrifer* Cope. Type. × 1. Section through symphysis of lower jaw.

The lower jaw is represented by Figures 4–6. The triturating surface (Fig. 4) is slightly concave transversely, strongly concave from the symphysis to the coronoid process. This bone is 48 mm. long. The triturating surface is 9 mm. wide, as wide as that of the jaw of a specimen of *T. latiremis* whose dentary is 87 mm. long. The inner face of the bone (Fig. 5) is occupied by a broad groove. The dentary has been suturally articulated with its fellow at the symphysis. Figure 6 presents a view of the symphysis.

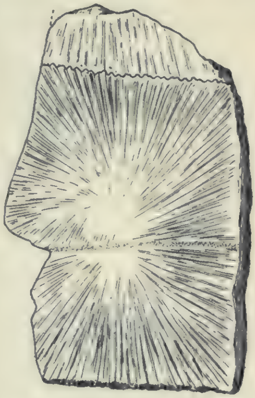

Fig. 7. *Toxochelys serrifer* Cope. Type. × 1. A peripheral bone.

One of the peripheral bones is shown by Figure 7, probably the penultimate of the left side. It resembles much the penultimate peripheral of *Colpochelys kempii*, except that the notch is deeper and the pit for the rib is at the hinder end of the inner face of the bone, instead of the front end. The peripherals are thin, only about 7 mm. thick; but this thinness may be partially due to crushing. The specimens described by Dr. E. C. Case under the name of *T. serrifer* are here made the types of a distinct species.

Toxochelys stenoporus, sp. nov.

The specimens which form the type of the present species were referred by Dr. E. C. Case (Univ. Geol. Surv. Kansas, IV, p. 379) to Cope's *T. serrifer*. Dr. Case did not have access to Cope's types and it is not surprising that he should have identified his materials as he did. The present writer has had the privilege of studying these materials in the collection of the University of Kansas.

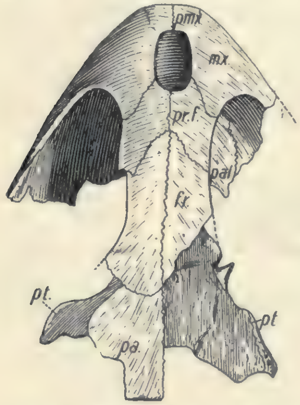

Fig. 8. *Toxochelys stenoporus* Hay. Type. × 1. Skull from above. *fr.*, frontal; *mx.*, maxilla; *pa.*, parietal; *pal.*, palatine; *pmx.*, premaxilla; *pr. f.*, prefrontal; *pt.*, pterygoid.

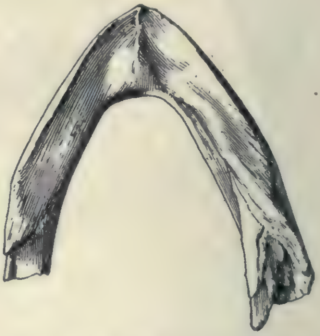

Fig. 9. *Toxochelys stenoporus* Hay. Type. × 1. Lower jaw from above.

Of the bones figured by Dr. Case, the skull, pl. lxxxii, figs. 4, 5, the peripherals of pl. lxxxiii, fig. 1, and the hypoplastron, pl. lxxx, fig. 3, are marked with the number 2060; while the elements furnishing the hypoplastron and the xiphiplastron of pl. lxxx, fig. 4, and the neurals and suprapygals of pl. lxxxiii, fig. 1, belong to number 1270, of the catalogue of the collection. There is no reason for doubting that all belong to the same species. It may be remarked that Dr. Case's figure representing the plastron of this species has been inverted.

Fig. 10. *Toxochelys stenoporus* Hay. Type. × 1. Dentary from inner side.

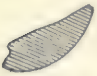

Fig. 11. *Toxochelys stenoporus* Hay. Type. × 1. Section through symphysis of lower jaw.

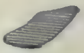

Fig. 12. *Toxochelys latiremis* Cope. Section through symphysis of lower jaw.

A new figure is here presented of the skull seen from above (Fig. 8). The most remarkable feature of the skull is the narrow nasal opening. This appears to be the natural condition, there being no evidence of crushing. The skull has evidently been relatively broad. The distance between the hinder ends of the maxillæ has equalled the distance from the snout to the middle of the basisphenoid; whereas, in *T. latiremis* the maxillary width reaches back only to the narrowest portion of the pterygoids. The masticatory surfaces of the jaws have been relatively broader than those of *T. latiremis*. Perhaps the most important differences between the two species, *T. serrifer* and *T. stenoporus*, are to be found in the lower jaws. The tip of the lower jaw of *T. serrifer* is rather blunt; that of *T. stenoporus* (Fig. 9) has been beaked. The length of the masticatory surface of the lower jaw of *T. serrifer* is 48 mm.; that of the type of *T. stenoporus* 33 mm. Notwithstanding this difference of length, the height of the inner face of the dentary of the two specimens is the same, 7 mm. Figure 10 shows the left dentary seen from the inner side. Figure 11 shows the form of the symphysis, and is to be compared with Figure 6, the symphysis of *T. serrifer*, and with Figure 12, the symphysis of *T. latiremis*.

Toxochelys procax, sp. nov.

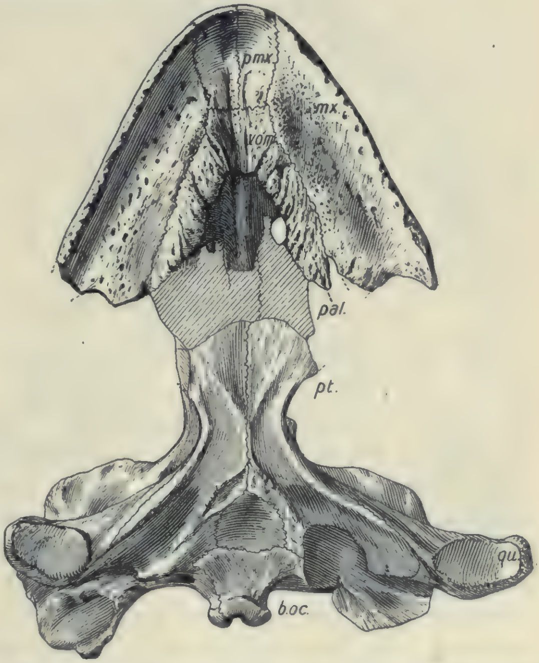

Fig. 13. *Toxochelys procax* Hay. Type. × ½. Skull from below. *b.oc.*, basioccipital; *mx.*, maxilla; *pal.*, palatine; *pmx.*, premaxilla; *pt.*, pterygoid; *qu.*, quadrate; *vom.*, vomer.

Toxochelys procax is based on a large skull which was found by Mr. H. T. Martin, in the Niobrara Cretaceous deposits along the Smoky Hill River, Kansas, in 1901. This was purchased for the American Museum of Natural History and now bears the number 234. The bones forming the roof of the skull behind the orbits are now missing, and the pterygoids are somewhat damaged. Only the tip of the lower jaw is present. The individual has been a large one, the length of the skull from the snout to the occipital condyle being 165 mm. The bones are rather massive and rough.

This species is to be distinguished from *T. latiremis* by the straighter outlines of the anterior half of the head (Fig. 13), the narrower pterygoids at the constricted portion, the somewhat more posteriorly placed choanæ, the broader articulation between the vomer and the maxillary processes of the palatines, and the broader and flatter symphysis of the lower jaw. As may be seen on examining Figure 14, the symphysis of *T. procax* is long and flat on the upper surface, and the hinder face stands at right angles with it and is traversed by a groove; while the symphysis of *T. latiremis* (Fig. 12) is slightly concave above and slopes downward and backward, and the hinder face is almost a continuation of the upper, sloping downward and backward, but more rapidly.

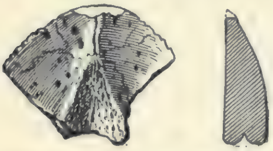

Fig. 14. *Toxochelys procax* Hay. Type. × ½. Top of lower jaw seen from above. Section through the symphysis.

The narrowest portion of the pterygoid region has a width of 22 mm., one-thirteenth of the length of the skull to the condyle; whereas, the pterygoid width of *T. latiremis* equals about one twenty-third of the skull length.

In *T. procax* there is a deep and rather abrupt longitudinal groove in the vomer and the lower surface of the premaxillæ. In *T. latiremis* this region is nearly flat. In *T. procax* the maxillary process of the palatine extends in front of the choana and forms an extensive contact with the vomer; in *T. latiremis* the contact is narrow.

Cynocercus incisus *Cope.*

The type of this species is in the American Museum of Natural History, having the catalogue number 1583. This type consists of two caudal vertebræ and a metapodial. These have been described and figured by Professor Cope in his work, 'Vertebrata of the Cretaceous Formations of the West,' p. 96, pl. viii, figs. 3–5. Dr. Case has redrawn and published the figures of the vertebræ in the 'University Geological Survey of Kansas,' IV, p. 369. No new facts have been learned regarding this species since its original publication. It has been suspected that these vertebræ are the caudals of *Toxochelys latiremis*. Dr. Baur has stated that the caudals of *Toxochelys* are procœlous; but this statement may rest on the assumption that *Cynocercus* is a synonym of *Toxochelys*. Dr. Case has stated that the locality where this species was discovered was not given by Cope; but this is an error. In the 'Proceedings of the American Philosophical Society,' XII, 1872, p. 308, Professor Cope says that it was found on Butte Creek, south of Fort Wallace.

Porthochelys laticeps *Williston.*

This fine species was described by Dr. S. W. Williston in the 'Transactions of the Kansas Academy of Science,' XVII, B. 1901. p. 195, pls. xviii–xxii. It was collected in the Niobrara deposits, on the Saline River, in Trego County, Kansas. It is represented by the skull, a large portion of the carapace, most of the plastron, and a humerus. The skull is remarkable for the massiveness of the jaws and for the breadth, this being equal to the length from the snout to the occipital condyle. The writer has nothing to add to the description, except that nasal bones are certainly present.

Porthochelys browni, sp. nov.

This species evidently attained a large size. The type materials were collected in 1903, by Mr. Barnum Brown, of the American Museum of Natural History, at a locality twenty miles south of Edgemont, South Dakota. From invertebrate remains collected at the same locality it has been determined that the deposits belong to the Pierre formation. The number of the specimen is 6080. The specimen includes the nearly complete skull and lower jaw, portions of the shoulder girdle, a humerus, the ulna and radius, a portion of the pelvis, a femur, and a tibia, together with some

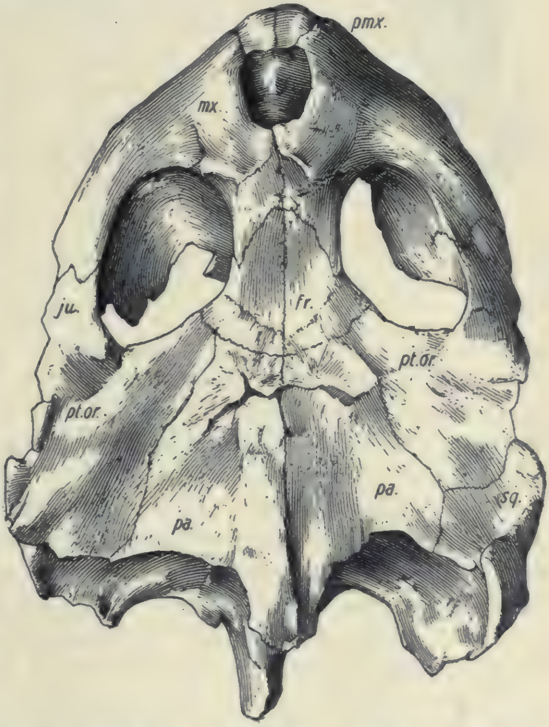

Fig. 15. *Porthochelys browni* Hay. Type. × ½. Skull from above. *fr.*, frontal; *ju.*, jugal: *mx.*, maxilla; *pa.*, parietal; *pmx.*, premaxilla; *pt. or.*, postfrontal; *sq.*, squamosal.

other fragmentary bones. All of these bones have suffered considerable crushing during fossilization, and are covered with a coating of gypsum. The sutures of the skull are mostly obscure.

The skull is large and broad (Fig. 15). It has apparently been rather depressed; but in the present condition of the specimen this cannot be determined with certainty. The length from the snout to the occipital condyle is 160 mm.; the width from the outside of one quadrate to the outside of the other is 142 mm. It will be seen, therefore, that the skull has not been relatively so broad as in *P. laticeps*, of the Niobrara formation. The temporal region is broadly roofed over, the posterior border of the roof permitting only a narrow border of the paroccipital to be seen from above. The suture between the squamosal and the parietal appears to have a length of about 20 mm. The orbits are large, the length being 50 mm., the height, 35 mm. Since the height of the orbits has almost exactly the same ratio to the length as is found in a specimen of *Chelonia mydas*, it seems probable that the skull was originally not much higher in the region of the orbits than now, and that the orbits looked strongly upward. The interorbital space has a width of 30 mm.

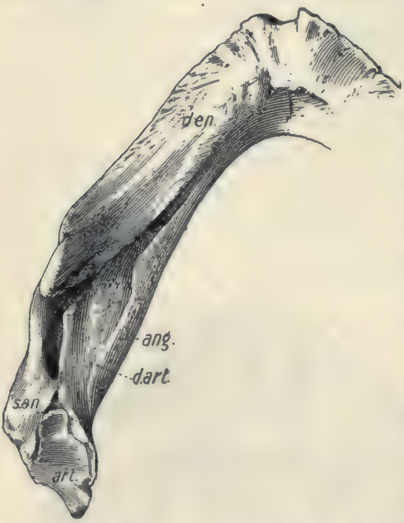

Fig. 16. *Porthochelys browni* Hay. Type. × ½. Lower jaw from above. *ang.*, angular; *art.*, articular; *d.art.*, dermarticular; *den.*, dentary; *s.an.* surangular.

The constricted portion of the pterygoid region has a width of 39 mm. The masticatory surface of the upper jaw is concave and has a width of about 25 mm. As in the other Toxochelyidæ, the maxillary process of the palatine bone reaches forward outside of the choana to meet the vomer. A broad pit in the lower surface of the premaxillæ has received the beak of the lower jaw.

The masticatory surface of the dentary bone (Fig. 16) has a length of 85 mm. This rises rapidly toward the coronoid process. This surface has been convex transversely and been 17 mm. wide. Its width does not increase backward, as it did in *P. laticeps*.

The humerus has a length of 157 mm. It appears to have resembled closely that of *Toxochelys latiremis*. The ulna measures in length 77 mm.; the radius, 85 mm. Thus these bones are respectively .49 and .54 of the length of the humerus. These ratios are close to those found in *Amyda spinifera*, although the ulna is a little more shortened. In the species just mentioned the ulna and radius are respectively .50 and .53 of the humeral length.

The femur has a portion of its distal end missing. The portion remaining has a length of 135 mm., hence the length could have been little short of that of the humerus. The tibia has a length of 110 mm. These measurements show that the hinder limb had suffered no reduction. The femur and tibia taken together were longer than the humerus and radius combined. This condition is what we find in *Chelydra*.

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Article XI. — NOTES ON AUSTRALIAN PENTATOMIDÆ, WITH DESCRIPTIONS OF A FEW NEW SPECIES.

By E. P. Van Duzee, Buffalo, N. Y.

Plate VIII.

I am indebted to Mr. Wm. Beutenmüller for the privilege of examining the fine series of Australian Pentatomids in the collection of the American Museum of Natural History in New York. Most of this Australian material, I am informed, was purchased from the estate of the actor, Henry Edwards, who at the time of his death in 1891 had one of the finest collections of Lepidoptera in this country. With the approval of Mr. Beutenmüller I have worked over this material in connection with the Australian Pentatomids in the National Museum which Dr. Howard very kindly sent me for study, and the Australian material in my own collection of Pentatomidæ. Among this material of mine are a few species obtained from a small lot collected in 1902 at Townsville, Queensland, by Mr. F. P. Dodd and purchased by me from a London dealer, that was of special interest in that it almost duplicated the material described by Dr. Distant in the 'Annals and Magazine of Natural History,' ser. 7, Vol. XIII, p. 263 *et seq.*, and included all but one of the new Pentatomids there described by him.

In studying this material I have had before me, or available for comparison, about one third of the species thus far recorded as Australian. These with the nearly complete literature of the subject have enabled me to place with reasonable certainty most of the species. Two or three of the fifteen species here described as new (*Dictyotus pallidus*, etc.) do not answer well to the genera in which I have placed them, and it is not impossible that they may have been described already, under some other genus, although I have taken every precaution possible to avoid such a redescription. The accompanying plate has been prepared in the hope that it may be of assistance in placing the new species. Here as elsewhere I use the term Pentatomidæ in its broadest sense and include in it the Plataspidæ, Scutelleridæ, and other subfamilies listed in the first volume of the Lethierry and Sevrin Catalogue.

PLATASPIDÆ.

Coptosoma frontata Montandon (Annals Museum Civ. di Genova, ser. 2, Volume XIV, p. 421, 1894). — Described from New Guinea.

Four examples of this species were in the lot collected by F. P. Dodd at Townsville, Queensland, July 2, 1902. These were kindly determined for me by Dr. W. L. Distant and differ from Montandon's description in being paler, the females especially being yellowish testaceous reticulated and punctured with brown on the posterior portion of the pronotum and the scutellum; the males are almost black, dotted and irrorated with pale; the tip of the tarsi and apical joint of the antennæ are very distinctly embrowned.

The Plataspidæ seem to be but poorly represented in Australia: eleven *Coptosomas* and one *Brachyplatys* having been described from that country.

SCUTELLERIDÆ.

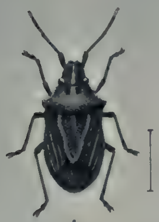
Coleoticus costatus *Linnæus.* — The American Museum material contains two examples taken in Queensland and numbered 332; in my own collection is an example from Alexandria, Victoria, kindly given me by Mr. G. W. Kirkaldy; and I have received from the National Museum a very clearly marked female labelled "New Caledonia."

Coleoticus artensis *Montrouzier.* — In the American Museum material is one specimen of this species from Queensland numbered 333. It may be roughly distinguished from the preceding by its shorter and broader form and by its having the punctures brown, omitting a slender longitudinal line.

Peltophora pedicellata *Kirby.* — The American Museum material contains one example from Brisbane, Queensland, and one from Goulbun, N. S. Wales, and in my own collection are specimens from Launceston and Tasmania.

Cantao parentum *White.* — Two examples of this species are in the American Museum material. They are labelled "Queensland, 319." This species closely resembles *rudis* but may be distinguished by the impunctate superior surface and the wider and more deflected head.

Tectocoris lineola *Linnæus.* — This common and widely distributed species is represented in the American Museum material by three varieties, all from Queensland: var. *schönherri* Esch. (No. 322), var. *banksi* Don. (No. 327), and a variety intermediate between these both in size and marking (No. 321). In my own collection are Australian examples from Brisbane, and from the National Museum I have received two small examples of var. *schönherri* Esch., and one of a variety that is almost completely black, all of these from New Caledonia.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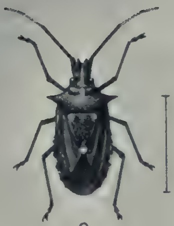
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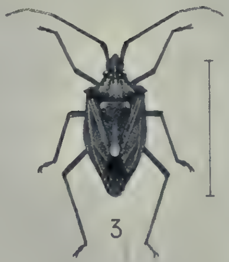
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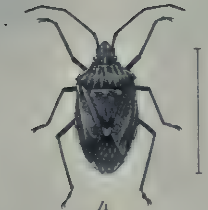
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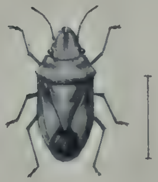
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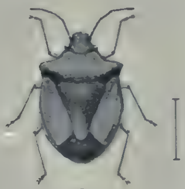
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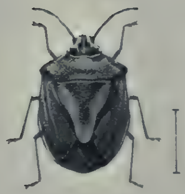
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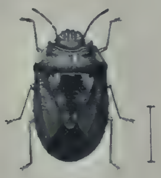
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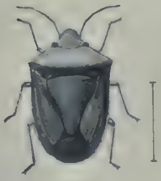
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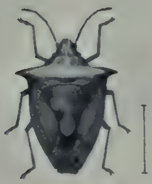
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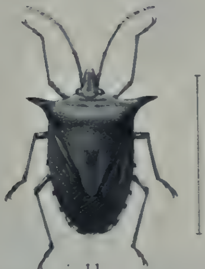
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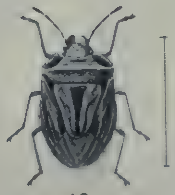
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1. Platycoris scutellatus n. sp.
2. Platycoris ? rufescens n. sp.
3. Pœcilometis stigmatus n. sp.
4. Pœcilometis edwardsi n. sp.
5. Menestheus brevis n. sp.
6. Dictyotus ? pallidus n. sp.
7. Antestia oliva n. sp.
8. Apines geminata n. sp.
9. Cuspicona carneola n. sp.
10. Cuspicona beutenmülleri n. sp.
11. Birorulus bibax *Breddin*.
12. Phyllocephala tumidifrons n. sp.

Pœcilocoris interruptus *Westwood.* — No species of this genus has heretofore been recorded from Australia, but in the material kindly sent me for study by Dr. Howard from the National Museum is one worn example undoubtedly of this species, that is labelled "New Holland." This specimen was determined by Dr. Signoret and sent by him to Dr. Fitch. In this example the sanguineous arcs on the pronotum almost meet before, forming practically a semicircle, and the transverse vitta on the scutellum is continuous. In all other respects it agrees with the published descriptions and figures of this species.

Chærocoris paganus *Fabricius.* — In the American Museum material are several examples of this species from Queensland, numbered 325, 326, and 328, and one smaller male from Victoria that I cannot separate specifically from the larger specimens. This specimen is paler, being mostly rufous, with the head, sides of the pronotum, and two large spots behind the middle of the scutellum blackish; beneath the sides of the pectus, a row of stigmatal spots and the apex of the sixth ventral segment are black; the form of this genital segment does not differ from that of the ordinary *paganus*.

Chærocoris variegatus *Dallas.* — Three examples of this strongly marked species are in the American Museum material labelled "Queensland, 331." One male is much darker than the females with the fulvous markings above reduced to mere lines and dots. In the National Museum are examples taken in Australia by Mr. Koebele.

Philia senator *Fabricius.* — Several Queensland examples of this common insect are in the American Museum material. Some of these (No. 323) have the ground color blue, others are larger and distinctly green in color (No. 324), and two (No. 21) want the orange collar on the base of the scutellum.

Calliphara imperialis *Fabricius.* — The American Museum material contains five examples of this fine insect. Four of these are labelled "Queensland, 318," the other is from Brisbane. This species is of a rich copper-red color above, with the head, submargin of the elytra, and apex of the scutellum metallic green or blue. It is the largest *Calliphara* known to me.

Calliphara regalis *Fabricius.* — Another brilliantly colored species of which the American Museum material contains one pair labelled "Queensland, 320." This species forms a transition between *imperialis* and *eximia*, a smaller species of which I have a long series from New Guinea, Buru, Tomia, and the Key Islands. Of this pair the female agrees in every particular with the female described by

Stal in 'Hemiptera Fabriciana,' I, p. 10. The male is more deeply colored, the head is deep green shading into rufous at the apex, with the base and middle line violet black; the anterior disk of the pronotum is quite widely invaded with metallic green, and the metallic green reflections over the whole surface of the pronotum and scutellum are much more conspicuous than in the female; the genital segment is black and the pectoral pieces in both sexes are quite broadly margined with rufous.

Calliscyta australis *Distant.* — Dr. Distant has very kindly sent me specimens of this that were taken in Queensland. In form, color, and pattern of marking this insect bears a very striking resemblance to *Chærocoris paganus.*

GRAPHOSOMIDÆ.

This subfamily is represented by five genera in the Australian fauna of which three — *Deroploa*, *Testrica*, and *Numilia* — are peculiar to that country. The following species are known to me:

Deroploa curvicornis *Stal.* — Two examples taken in New South Wales by Mr. Macleay are in the American Museum material. These agree with Stal's diagnosis except that the humeral horns are not at all narrowed toward their apex. This is an odd-looking little bug with its long curved thoracic horns and the projecting spinose cheeks.

Testrica rudis *Germar.* — This is a rough-looking little chap with a superficial resemblance to a *Podops.* A pair in the American Museum material were taken in New South Wales by Mr. Macleay.

Testrica bubala *Stal.* — One pair taken with the preceding is in the American Museum collection. It is a smaller species than *rudis* with the humeri acutely produced like a miniature *Euschistus heros.*

CYDNIDÆ.

Twenty-five or more species of this subfamily have been described from Australia but none of these are in the collection of the American Museum and they are entirely unrepresented in my own collection as well.

PENTATOMIDÆ.

Platycoris scutellatus, sp. nov.

(Pl. VIII, fig. 1.)

Ovate, rather elongate, flavotestaceous, above closely covered with regularly disposed blackish punctures; a longitudinal median vitta, widened from the tip of the tylus to the middle of the pronotum where it becomes abruptly slender and then obsolete near the middle of the scutellum; the margins of the latter, the narrow outer edge of the pronotum and costa at base, and the longitudinal discal nervure of the elytra are pale, calloused, and impunctate. The pale vittæ are in places bordered with a blackish shade. Beneath paler with three longitudinal rows of black points on the disk of the venter and an incomplete dusky annulus about the pale stigmata, more conspicuous in the females. Antennæ rufofuscous, first joint considerably thickened except at base; second as long as the two apical united; third equal to the first; fourth shortest, subfusiform. Rostrum attaining the hind coxæ, second joint a little longer than the third, the median line and apical joint black. Legs rufescent, base of the femora paler; tarsi blackish at apex. Connexivum rather broadly exposed beyond the closed elytra, black within, pale without. Membrane more or less discolored with the nervures paler. Genital segment of the male with a broad shallow sinus, the outer angles rounded. Length 7–8 mm. Humeral width 4 mm.

I cannot identify this insect with any described species of *Platycoris*. It seems to be rather more elongated in form than is indicated in the generic characters given by Amyot and Serville. The latero-anterior margins of the pronotum are rather deeply sinuated and feebly crenulated anteriorly; the humeri are prominent but obtuse; the cheeks are truncated and slightly oblique at apex where they surpass the tylus but do not approach; the ocelli are distinct and a little nearer the eyes than to one another; the basal joint of the antennæ exceeds the apex of the head by more than one half its length; the scutellum is rather long, reaching for two thirds the length of the abdomen, and is obtuse but scarcely rounded at apex. Beneath the buculæ are a little more elevated anteriorly, reach about to the base of the head, and slightly exceed the first joint of the rostrum; the pleural pieces are closely and coarsely punctured; the osteolar canal is very short, abrupt and strongly elevated at apex; the venter is closely, finely, and rather obscurely punctured, has no indication of a median sulcus or basal tubercle, and has the outer edge smooth.

Platycoris ? rufescens, sp. nov.

(Pl. VIII, fig. 2.)

Larger and more oblong than the preceding and with more acute humeri. Dark rufopiceous becoming more or less blackish on the base of the head, anterior margin, and lateral disk of the pronotum and scutellum; paler beneath. Above closely covered with rather strong and, in places, rugose punctures; a median longitudinal vitta on the head and pronotum, becoming broadest between the callosities, the narrow latero-anterior margins of the pronotum, three spots on the base of the scutellum and a larger one on its apex, pale, calloused, and impunctate. Elytra rufescent, a little paler on the clavus and costal area where the punctures become slightly embrowned; membrane pellucid; tergum black, connexivum and genital segment above and disk of the sixth tergal segment pale rufous, the former with a black band on the incisures. Antennæ black, first joint short, scarcely passing the apex of the head; second joint more than three times the length of the basal [remaining joints wanting]. Beneath paler or almost flavotestaceous; an indefinite spot on the base of the coxæ, an incomplete lateral vitta from the eye almost to the base of the abdomen, stigmata, and a row of marginal dots placed on the apex of the segments, black. The black pectoral markings show a tendency to become metallic green especially behind the eyes. Punctures on the pectoral pieces strong and irregular, on the venter indistinct and scattering. Legs more rufescent with the tarsi blackish. Rostrum reaching the hind coxæ, the median line and apical joint black; second joint distinctly longer than the third. Buculæ less elevated than in *scutellatus*, shorter than the basal joint of the rostrum and not attaining the base of the head. Genital segment of the male very deeply emarginate, almost falcate. In both sexes the sixth ventral segment has a median longitudinal black dash. Length 11–12 mm., humeral width 5 mm.

Described from one pair in the American Museum collection that were taken in New South Wales by Mr. Macleay. This species differs from the preceding in its generic characters in having the basal joint of the antennæ proportionately shorter, the humeral angles produced in acute prominent spines, and the scutellum shorter, reaching hardly beyond the middle of the abdomen, and more abruptly narrowed to the more slender and rounded apex. The cheeks are somewhat concave above, considerably longer than the tylus, and divergent and subacute at apex. The latero-anterior margins of the pronotum are deeply sinuated and almost smooth, and the humeri are blackish both above and below. With my present knowledge of the allied species I would not feel justified in establishing a new genus for this species although in time such a disposition may have to be made of one or both of the forms here described.

Niarius venosus *Stal.* — In my own collection are two typical examples of this species that were taken at Townsville, Queensland, by Mr. F. P. Dodd. The American Museum has two darker specimens from New South Wales. These differ from the more typical examples in having the head more narrowed and crenulated anteriorly with the pale border narrower and less conspicuous. The pronotum is blacker, with the pale longitudinal line on the anterior lobe only. The scutellum wants the lateral pale points on the base and the apex is narrower, less acute at the tip, and not so broadly pale; the pale veins on the disk of the elytra are scarcely indicated, and the chest wants the pale spots at the base of the feet. These differences seem too slight to found a new species upon, especially as both examples are badly greased, but a larger series might show it to be distinct.

Niarius illuminatus *Distant.* — The American Museum material contains one pale and one darker example of this species, the former from New South Wales, the latter from Victoria. In the dark specimen the median pale line on the head is nearly obsolete. In neither is the disk of the venter distinctly luteous. Two other Australian species have been described in this genus.

Oncocoris cœlebs *Fabricius.* — I possess three examples of this species taken by Mr. Dodd in Townsville. These show considerable variation in the depth of coloring. One female is particularly pale, with the dark markings described by Stal scarcely indicated, the whole upper surface being quite uniformly punctured with brown. The dark examples show a well-defined pale point on the disk of the elytra.

Notius depressus *Dallas.* — One pair of this species is in the American Museum material and a male taken in Australia is in the National Museum collection. Of the American Museum specimens the male, which is smaller and piceous brown, with scarcely an indication of green, is from Victoria; the female is larger with a deep blackish green ground color and was taken in New South Wales by Mr. Macleay.

Hypogomphus rugosus *Spinola*? — The American Museum possesses a pair of this species that was taken in Queensland. It is of the size of *bipunctatus* Guérin, but differs in having the apex of the scutellum pale and the legs testaceous with the apex of the femora and tibiæ fuscous. From *rotundatus* it differs in having the edge of the pronotum concolorous and the apex of the scutellum rather narrow and feebly bifid in the male, as well as by its larger size.

Omyta centrolineata *Westwood.* — In my collection is a single specimen of this species labelled "Tasmania." So far as I can learn it has heretofore been taken only in Australia.

Alcæus varicornis *Westwood.* — Four examples of this conspicuous species are in the American Museum collection, all from Victoria. It may be recognized by the pale spot in the anterior disk of the pronotum and the elevated apical margin of the scutellum. It has much the form and aspect of the North American *Brochymena 4-pustulata.* An allied species, *A. subspinosus* Dallas, differs in having the humeri less prominent, the apex of the head narrower, and the antennæ shorter. It is unknown to me.

Thesus modestus *Stal.* — Two examples taken in New South

Wales by Mr. Macleay are in the American Museum material. I have in my own collection two specimens taken at Townsville, in October, 1902, by Mr. F. P. Dodd, and two from Rockhampton. These six examples vary considerably in their depth of coloring but none is black enough to be placed under Dr. Distant's new species, *nigrescens* (Ann. Mag. Nat. Hist., ser. 7, Vol. XIII, p. 263, 1904).

Spudius latus *Walker.* — Among the material taken by Mr. Dodd at Townsville are two females of this large handsome species. I feel satisfied with the correctness of this determination although the specimens differ from Walker's description in having from four to six abrupt irregular teeth on the latero-anterior margin of the pronotum. This insect is of a cinereous gray color with four blackish spots or a transverse band across the disk of the pronotum, two similar spots behind the basal angles of the scutellum, another on the anterior disk of each elytron, and an ill-defined bilobed band opposite the apex of the scutellum.

Spudius reticulatus *Dallas.* — A male and two females of this species are in the American Museum material. These were collected in New South Wales by Mr. Macleay. This is a smaller and narrower species than the preceding and has a group of metallic green punctures on the basal angles of the scutellum, a shorter rostrum which barely reaches on to the third ventral segment, and has but two or three very small teeth on the latero-anterior margin of the pronotum.

Genus Eumecopus *Dallas.*

This is distinctively an Australian genus. So far as I can make out sixteen species have been described of which I have seen but seven. I have, however, been over the descriptions of all the species with care and give here an adaptation of Stal's key to the groups of species in the hope that it may be of some service in placing these closely allied forms.

- *A.* Angles of the abdominal segments pale.
  - *b.* Rostrum reaching the third ventral segment.
    - *c.* Margins of the scutellum pale.
      longicornis Dall., *nigricornis* Stal, *pallescens* Dist.
    - *cc.* Scutellum with the angles only pale.
      armatus Fabr., *apicalis* Westw., *callidus* Walk., *ruficornis* Walk., *abdominalis* Dist.
  - *bb.* Rostrum reaching on to the second ventral segment.
    - *d.* Ventral margin pale with a dark vitta.
      vittiventris Stal.

dd. Ventral margin narrowly yellow or the whole venter pale.
australasiæ Don., *punctiventris* Stal.
ddd. Ventral margin alternated.
cognatus Walk., *conspersus* Walk.
AA. Angles of the abdominal segments black.
patruelis Walk., *acanthopygicus* Stal, *fuscescens* Stal.

Eumecopus pallescens *Distant.* — This is the neatest and most graceful species I have yet seen of this interesting genus. It was described by Dr. Distant in the 'Annals and Magazine of Natural History,' ser. 7, Vol. XIII, p. 264, 1904, from material taken by Mr. F. P. Dodd at Townsville, North Queensland. I possess two females and two nymphs taken by Mr. Dodd at the same locality in February, 1903. It may easily be recognized by its pale gray color, with the scutellum, four rays on the pronotum, and another on the disk of the elytra, ferruginous, and by the pale median line and margins of the scutellum.

Eumecopus callidus *Walker.* — Two examples of this brightly colored species are in the lot received from the American Museum. They are from New South Wales. This species is easily distinguished by its bright reddish tint, the broad blackish submargins and median line of the pronotum, the dark scutellum with imperfect median line and large pale cali in the angles, and the conspicuous black ray on the disk of the elytra. In the male the venter is almost uniformly castaneous with an indistinct discal vitta on each side which becomes more accentuated posteriorly. In the female a median castaneous vitta on the venter is bisected by the pale sulcus.

Eumecopus abdominalis *Distant.* — This species, which was described by Dr. Distant in the same paper with his *E. pallescens* at page 263, is closely related to *callidus*. It is, however, proportionately broader with a shorter head and wants the black markings above, the venter is uniformly castaneous, and there is a pair of minute pale points on the anterior disk of the pronotum and a larger one on the disk of each elytron. I possess one female taken at Townsville, Queensland, in October, 1903, by Mr. F. P. Dodd, and Dr. Distant's type was from the same source.

Eumecopus australasiæ *Donovan.* — The American Museum material contains one example of this darkly colored species that was taken in New South Wales. The venter is blackish with a series of vague or ill-defined spots on either side of the median line and a smaller one on either side of each of the stigmata, these forming one longitudinal row, and the extreme edge is also pale.

Eumecopus cognatus *Walker.* — This insect very strongly resembles the preceding but is somewhat smaller and more slender and the venter is pale with the narrow base of each segment and a broad serrated stigmatal vitta on each side, black; the irregularities on the discal side of this vitta are very indefinite, while without they are well defined as a squarish spot on the incisures that touch the edge of the abdomen. One female specimen is in the American Museum material labelled South Australia, and another taken in Australia by Mr. Koebele is in the National Museum. This species and the next belong to a section of the genus not represented in Stal's synopsis. This section is equivalent to his sections "*d*" and "*dd*" and may be characterized by having the margins of the venter alternately light and dark.

Eumecopus conspersus *Walker.* — I place this species with a little doubt. It is of a dark fuscous rather than black color; the second antennal joint is somewhat less than one half the length of the third; the bases of the third and fourth joints are pale as well as that of the second; the pale irrorations on the scutellum do not form "lateral streaks" as indicated by Walker; and the elytra have a distinct pale discal point not mentioned by him. Aside from these points his description fits these specimens perfectly and I can find no reason for considering the species distinct or even for describing it as a variety. Two specimens in the American Museum material are labelled New South Wales.

Eumecopus patruelis *Stal.* — This species is even larger than *australasiæ* and somewhat resembles the Asiatic *Erthesina fullo.* I have received two males from Hermann Rolle that were taken at Renmark, South Australia.

Pœcilometis rufescens *Westwood.* — This is a remarkably neat-looking insect. The upper surface is uniformly reddish ferruginous, very regularly and closely covered with distinct dusky punctures; the narrow latero-anterior margins of the pronotum, the costa at base, a spot at each basal angle of the scutellum and another at its apex, are pale yellowish; elytra with a conspicuous round black dot on the disk posteriorly. Whole lower surface and legs pale fulvous yellow sprinkled with scattering blackish punctures, those on the venter less conspicuous in the female; apex of the posterior femora and tibiæ, tips of the tarsi, stigmata, a round dot on either side of the mesopleura, two smaller ones on the propleura, and the apex of the rostrum black. The sixth ventral segment in the female has an imperfect median black line, and the base of the genital segment of the male is polished black. Antennæ rufescent, basal joint dusky (fourth and fifth wanting in the specimens before me).

One pair of this pretty species from New South Wales is in the American Museum material.

Pœcilometis gravis *Westwood.* — This is another neat, pretty species of which one female is in the National Museum material received from Dr. Howard. It closely resembles *rufescens* but is proportionately a little broader and more closely punctate with black, giving the insect a darker appearance, while the ground color is really paler and less reddish than in its ally. The penultimate ventral segment has a longitudinal median black vitta; the stigmata, apex of the tarsi, apical joint of the rostrum, and apical one third of the posterior femora are black; the venter is dotted with scattering ferruginous punctures on a clear almost rufous ground, and the pleural pieces and legs are much paler and are similarly dotted with black punctures. The rostrum attains the middle of the third ventral segment. The antennæ reach to about the apex of the corium; the first joint is blackish, the others are pallid, or those toward the apex may be a little darker. This specimen is labelled "Australia, Koebele."

Pœcilometis strigatus *Westwood.* — I have one example taken in New South Wales and received from Hermann Rolle that I place here with some doubt. The ground color is pale luteous tinged with ferruginous, closely, and in places confluently, punctured with blackish; these punctures on the pronotum and scutellum are so closely crowded as to give those parts a blackish appearance. On the head these punctures form two longitudinal lines, which become slender and geminate on the posterior one-half, and there is a black vitta behind the red ocelli. On the pronotum the callosities, a slender almost obsolete median line, and the narrow anterior and lateral margins are pale. The scutellum has but two pale basal points, not three as described by Westwood, and there is an irregular blackish cloud on the disk of each elytron. The antennæ are apparently five-jointed although the three basal only remain in this specimen; these three are ferruginous, the basal punctured and the third tipped with black. Beneath pale fulvous, irregularly punctured with dusky, and with the stigmata and about three points on the pleural pieces black. This latter character is not mentioned by Westwood.

This genus differs from *Eumecopus* in having the humeri angulated but not spinous. Of the thirteen species listed by Lethierry and Sevrin, 'Catalogue Général des Hèmipteres,' I, p. 96, four must be eliminated: *cognatus*, *conspersus*, and *ruficornis* of Walker belong to

Eumecopus, and *modestus* Stal is an erroneous entry. It is listed on the preceding page under genus *Thesus* where it belongs. I now add two new species having four-jointed antennæ and pertaining to section "*bb*" of Stal's synopsis of this genus in the 'Enumeratio,' V, p. 42.

Pœcilometis stigmatus, sp. nov.

(Pl. VIII, fig. 3.)

Allied to *strigatus* in form and color. Pale yellowish testaceous, closely and quite uniformly punctured with ferruginous. Head with about seven longitudinal impunctate lines. Pronotum a little clouded with ferruginous near the fore border where there are about three pale longitudinal lines; lateral margins rather strongly sinuated, narrowly pale. Scutellum darker than the rest of the upper surface, three points on the base and the apex pale. Punctures on the elytra more irregular, forming a more or less distinct oblique cloud behind the middle of the disk; membrane fuliginous with the apical margin and the nervures broadly hyaline. Tergum apparently blackish; connexivum pale. Beneath pale yellowish testaceous; stigmata, a round dot on the mesopleura, two smaller ones on the propleura, metasternum, and the median line and apex of the rostrum, black. Legs pale, more or less distinctly irrorated with ferruginous; apex of the posterior femora and tibiæ blackish above; claws black. Antennæ rufescent, apparently of four joints; basal ferruginous, obscurely irrorate with pale; second more than twice the length of the first, others wanting. Length to tip of the membrane 17–18 mm.; humeral width 7 mm.

In this species the rostrum passes the middle of the third ventral segment, the disk of the venter is impunctate but the sides have obsolete concolorous punctures; the propleura, the mesopleura and metapleura in part are coarsely punctate with ferruginous.

New South Wales. Described from one male received from Hermann Rolle and a female belonging to the American Museum of Natural History.

Pœcilometis edwardsi, sp. nov.

(Pl. VIII, fig. 4.)

Broader and shorter than *strigatus*. Pale yellowish, clouded and punctured with fusco-ferruginous. Head rather short; median disk of the cheeks punctured and clouded with ferruginous brown, a longitudinal line on either side of the tylus, a broader arc interior to the eye, and a spot behind the ocelli, black. Base of the vertex with a geminate brown vitta either side of the pale longitudinal median line. Pronotum with a dusky longitudinal vitta either side of the middle, another within the pale latero-anterior margins, and one or two obsolete ones between these brown. Scutellum with the basal angles and apex pale, impunctate; posterior one half with an obsolete double pale longitudinal line. Elytra showing a more or less distinct blackish discal spot. Membrane fuliginous broadly veined with hyaline. Tergum black, connexivum narrowly pale. Antennæ black, four-jointed; apical two joints paler with their bases broadly fulvous; second joint nearly twice the length of the first, third shorter, fourth about equal to the first. Beneath pale yellowish-testaceous, pleural pieces sparsely punctured with dusky. Venter with a few scattering large black punctures; stigmata, a dash on the basal middle of the sixth ventral segment in the female, a round dot on the metapleura, and two smaller ones on the propleura, black. Rostrum reaching only to the base of the second ventral segment, its tip black. Legs pale, femora with coarse blackish punctures, a line on the anterior and intermediate femora toward their apex, apical upper surface of the posterior, tips of the tibiæ, and apical joint of the tarsi, black. Length 16 mm.; humeral width 7 mm.

Described from three female examples in the American Museum material that were taken in Victoria, and one female received from the National Museum bearing the label "Williamston, 22–10–88, Tepper." This insect I would identify with Stal's *Eumecopus punctiventris* were it not that it is smaller and is a typical *Pœcilometis*, and not an *Eumecopus* at all. Stal certainly would not have confused the species in these two genera. *Edwardsi* may be distinguished by its broader form and shorter rostrum.

Aglaophon varius *Stal.* — The American Museum collection has one pair of this pretty species. The female is a little broader than the male, the pronotum is blackish with a broad median and a narrow lateral vitta pale and black-punctate, the former with two short approximate longitudinal black lines behind the pale anterior margin; the intervening broad black vitta is marked with a few pale dots arranged as a broken longitudinal line. Scutellum mostly black with a few pale marks on the sides and median line. Elytra more cinereous with two blackish patches on the disk and another at the apex. Lower surface yellowish testaceous; a submarginal lateral vitta, mesosternum, and a small spot at the base of each ventral segment either side of the median sulcus, black. Pale base of the apical two joints of the antennæ much broader than in the male. The male agrees very closely with Stal's description except that the color of the venter and of the dark markings above is dark chestnut rather than black. In this species the basal joint of the antennæ scarcely exceeds the tip of the tylus, and the fifth joint is obviously shorter than the third and fourth joints. The connexivum is pale with the incisures and a few punctures blackish. The present specimens are labelled "New South Wales."

Sciocoris indicator *Walker?* — One example that I hesitatingly identify with Walker's species is in the material sent by Dr. Howard, from the National Museum. This individual is but 4 mm. in length and agrees quite closely with Walker's description but I would not call the "head much longer than broad," nor would I describe the cheeks as "pointed," although they are oblique at their broad apex and the inner angle is subacute before the apex of the tylus. This specimen is labelled "Burnside, 5–7–84, Tepper."

Menestheus nercivus *Dallas?* — The American Museum lot contains two examples that I place here with some doubt. Both agree very closely with Dallas's description in form and one has the same subferruginous color, the other is pale or grayish. The brown punctures tend to form an ill-defined vitta within the lateral margins of the head and pronotum, and a median less distinct band on the base of the head; the inner margin of the cheeks, an obsolete median line on the tylus extending to the base of the head, an oval spot between the eye and the ocellus, the callosities, about five indistinct longitudinal vittæ on the scutellum, and the elytral nervures are impunctate and obscurely calloused. Beneath the punctures form a faint longitudinal vitta next the margins and including the black stigmata, and about midway between this vitta and the median line is a similar but fainter vitta including a row of black points—about five on the pectoral pieces and four that are elongated and impressed, situated on segments three to six of the venter. The fourth and fifth joints of the antennæ are elongated and much thicker than the others, and the rostrum attains the posterior coxæ. Most of these characters are obscure and might readily have been neglected by Dallas, but it seems singular that he should have mentioned the black impressed points on the basal angles of the scutellum and have overlooked the equally distinct row interior to the stigmata. In this species about a third of the length of the head projects before the buculæ. Both specimens before me are males and measure 13 and 14 mm. in length, the apex of the genital segment is strongly trisinuate with the median sinus broader and deeper than the lateral, and the enclosing angles prominent and subacute. The dorsum of the abdomen is dark ferruginous brown with the margins broadly pale. Taken in New South Wales.

Menestheus brevis, sp. nov.

(Pl. VIII, fig. 5.)

Closely allied to the preceding but proportionately broader and shorter and with the head less attenuated anteriorly. Pale ferruginous, rather closely and coarsely, but irregularly punctured above, these punctures forming three broad blackish vittæ on the head, one medial and two marginal, the former bisected by an indistinct pale longitudinal line that is distinguishable across the pronotum and on to the tip of the scutellum. Beyond the middle of the scutellum this vitta becomes slightly raised or calloused. Basal angles of the scutellum with an impressed black point within which is a small oblique pale callous. Beneath with two longitudinal vittæ of blackish punctures, one submarginal including the black stigmata and becoming subobsolete on the venter, the other interior to this and more pronounced but wanting the black points so conspicuous in *nercivus*. Legs, antennæ, and rostrum concolorous, the last with the median line and apex black and attaining the posterior coxæ. Length 10 mm.; humeral width 4 mm.

This species may be distinguished from the preceding by the form of the head, which is much shorter and more rounded at apex while it exceeds the buculæ by about the length of the basal joint of the antennæ. The edges of the head are very feebly sinuated before the eyes and well rounded toward the apex. The apex of the genital segment of the male has a deep subangular median sinus, with the outer angles obtusely rounded. The genital valves of the female are obtuse at apex.

Described from one pair in the American Museum collection, labelled "New South Wales."

Eribotes australis *Dallas*. — Two examples of this small obscure species are in the American Museum material. These, which are from New South Wales, agree very closely with Dallas's figure and description but are paler with the dark markings but poorly defined.

Cephaloplatys spurcatus *Walker*. — Two examples are in the American Museum lot. They are dark brownish fuscous above, but they are badly greased and the color has probably been darkened. This species may be distinguished from its congeners by having the expanded latero-anterior margin of the pronotum serrated. These specimens are from New South Wales.

Dictyotus cænosus *Westwood* (=*vilis* Walker, =*polystictus* White). — Mr. G. W. Kirkaldy has sent me specimens of this species taken in New Zealand and the present collection contains material from the same country and others from Victoria and New South Wales. It seems to be a common and widely distributed species. It is very uniformly colored but some specimens exhibit a slight gathering of black punctures near the anterior angles of the pronotum; the antennæ have the three last joints black; the rostrum reaches the intermediate coxæ; sometimes the scutellum has three very obscure pale dots on the base, and its calloused apex is paler and bisected by a wedge of black punctures in the darker examples; the lower surface and femora are more strongly punctured than in some of the species known to me. In this species the head is broad and flat, the cheeks are very feebly sinuated and obscurely whitish on their margins before the eyes, and at their apex they meet or almost meet before the apex of the tylus.

Dictyotus bipunctatus *Dallas.* — I have received one example bearing this name, from the National Museum. It agrees very well with Dallas's description, except that the antennæ are black, with the first joint and base of the second only pale, and the whitish latero-anterior edge of the pronotum is broad. It is labelled "Karabba, under logs, etc., 9–11–86."

Dictyotus roei *Westwood.* — According to Dr. Distant this is *Dictyotus affinis* of Dallas. It is a little smaller than *æqualis* and has more prominent humeri. It is more closely related to *cænosus* but the head is broader anteriorly with the sides more deeply sinuated and the apex distinctly emarginated; the antennæ have the fifth joint and the apical three fourths of the fourth only black; the latero-anterior margins of the pronotum are very narrowly pale and sometimes obscurely interrupted with blackish before the humeri; there is a pale point within the impressed black basal angles of the scutellum and its apex is narrowly tipped with pale. The genital and sixth segments have about the same form as in *cænosus.* The base of the venter has a black spot on each side of the second segment, and the sternum is quite broadly black. In this species the veins of the membrane are but little reticulated toward their base.

There are five examples labelled "Victoria" and "South Australia" in the American Museum material.

Dictyotus æqualis *Walker.* — Dr. Distant informs us that this is the *Dictyotus roei* of Dallas but not of Westwood. It is more regularly oval than any of the other species known to me, and bears a strong resemblance to the North American *Peribalus limbolarius.* The upper surface is roughly punctured and much obscured in places with blackish, especially on the sides of the head and within the lateral margins of the pronotum; the latero-anterior margins of the pronotum, base of the costa, and apex of the scutellum are more conspicuously pale than in the other species known to me, and the two apical joints only of the antennæ are black. Beneath the surface is paler and sprinkled with rufous points and there are three black points on each side of the sternum. The scutellum has three pale points on its base and there is a blackish punctured area on either side bounding the pale apex. In the male the sixth segment is rounded and scarcely produced anteriorly, not strongly and almost acutely produced as in *cænosus*.

One pair of this species is in the American Museum material. The male is from Victoria and the female from South Australia.

Dictyotus laticeps *Walker* (*Pentatoma laticeps*, Catalogue Heteroptera, II, p. 308, 1867). — This is a larger species than *cænosus*, and may be at once distinguished by having the veins of the membrane simple or simply forked; the head is broad and short, narrow and rounded before, with the cheeks almost meeting before the apex of the tylus, and marked with a large blackish cloud which sends back a broad vitta enclosing the ocelli. The pronotum is transversely corrugated, especially between the humeral angles, with the sides narrowly pale and bordered within by a blackish cloud; the scutellum has the usual blackish pits at the basal angles and between these three obscure pale points, and the tip is rather narrow, obtuse, and concolorous; elytral costa pale at base, within which is a faint blackish ray; connexivum concolorous with but a narrow vitta on the hind edge of each segment; beneath the color is paler with the stigmata, three dots on the pleural pieces, and the tip of the rostrum black. The antennæ are in poor condition in the only specimens I have seen, but they seem to have the apex of the second and third joints, the fourth except its base, and the fifth, black.

I cannot find that this species has been recognized by recent entomologists, but possibly Dr. Distant has reported on it in his Rhynchotal Notes on the Pentatomidæ of the British Museum, a paper that unfortunately I have thus far been unable to procure.

Two females in the American Museum collection are from Victoria and a male in the National Museum lot was taken in Australia by Tepper, November 20, 1883.

Dictyotus ? pallidus, sp. nov.

(Pl. VIII, fig. 6.)

Form and aspect of the North American *Thyanta rugulosa*. Whitish testaceous, a little darker on the apex of the antennæ and tarsi; tip of the rostrum piceous.

Above finely and rugosely punctate; pleural pieces coarsely punctate, venter almost smooth; punctures concolorous or nearly so. Head long, apex broadly rounded, sides deeply sinuated, cheeks exceeding the tylus and contiguous before its apex; ocelli placed near the eyes. Antennæ, basal joint not attaining the apex of the head, second longest, third little longer than the first, fourth and fifth somewhat thickened, fourth nearly as long as the second, fifth a little shorter. Pronotum broad, sides deeply sinuated, leaving the humeri prominent but obtuse; scutellum long, apex obtuse, basal angles without the impressed fovæ; elytra broad, but little narrower than the abdomen; membrane closely reticulated. Rostrum reaching the posterior coxæ, second joint distinctly longer than the third. Sternum ecarinate. Osteolar canal long but truncated at its apex, not gradually evanescent. Venter smooth on its disk with a row of large dusky points close to the apical margin of the third and fourth segments, the sides with coarse shallow punctures. Legs obscurely dotted with brown; tibiæ sulcate, second tarsal joint very short. Length 7–8 mm., humeral width 4½–5 mm.

New South Wales. Three examples are in the American Museum material. This insect is not a typical *Dictyotus*. It wants the impressed fovæ at the basal angles of the scutellum and has a longer osteolar canal. It differs from the American *Thyanta* in the reticulated membrane and the longer contiguous cheeks. From *Liotropis* it differs in the unarmed second ventral segment. Judging from its pale color it probably is an inhabitant of the arid sandy deserts of Central and Southern Australia.

Anaxarchus pardalinus *Stal.* — I have received several examples of this fine species from Hermann Rolle that were captured in New South Wales. They may be recognized by their fulvous color, punctured with black above, and the alternated connexivum. The apex of the scutellum is bright fulvous and the basal angles have a black pit next to a pale callous. The antennæ are black with the apical joint fulvous. The legs and lower surface are orange fulvous with seven rows of black spots on the venter, those of the median row larger.

Eysarcoris sp. — I possess a single example of a species of *Eysarcoris* that I have been unable to determine.

Agonoscelis rutila *Fabricius.* — The American Museum material includes two examples of this common species from New South Wales and two from Darnley Island. My own material is from Tomia and the Key Islands.

Aplerotus maculatus *Dallas.* — The material received from the National Museum contains one example of this species taken in Australia by Mr. Koebele. This specimen is rather pale in color and possibly is not fully developed.

Catacanthus nigripes *Sulz.* — Two examples in the American Museum lot are labelled "Queensland, 341." This species and *carrenoi* are very closely allied. Stal distinguishes the latter by its having the apex of the membrane pale beyond the end of the abdomen. *Carrenoi* is represented in my collection by specimens from the

Philippines and the island of Tomia; *nigripes* I have from Java. Both are brightly colored and showy insects.

Commius elegans *Donovan.* — The American Museum lot contains a pair of this very pretty species from Victoria and New South Wales. It has much the aspect of the South American genus *Runibia.*

Anaxilaus camatulus *Dallas.* — New South Wales. Two examples are in the American Museum material. These agree exactly with the specimen in the Holm Museum described by Stal (Enumeratio, V, p. 90). From the National Museum I have received a specimen that is considerably darker, the pronotum and elytra being closely covered with dusky punctures, making a transition from the pale Australian variety mentioned above to the dark form figured by Herrich-Schæffer.

Hyrmine dispar *Westwood.* — New South Wales. Three examples in my collection were received from Hermann Rolle. This insect is intensely black with an orange abdomen.

Plautia affinis *Dallas.* — Four examples of this species in my own collection were taken in Townsville, Queensland, by Mr. F. P. Dodd. This species is most closely related to *fimbriata* but may be distinguished by its paler colors, and its coarser and stronger punctuation. All my specimens have a conspicuous black spot on the disk of each elytron, and the edge of the abdomen is dotted with black as in *fimbriata.*

Plautia brunneipennis *Montrouzier.* — This insect resembles *fimbriata* even more strongly than does *affinis.* It has the same size, form, and color, but it is more strongly punctured, the apical margin of the scutellum is pallid, and the edge of the abdomen is without the black points found in that species and *affinis.* The American Museum material contains two examples from New South Wales and one from Brisbane, Queensland.

Zangis montrouzieri *Lethierry & Sevrin?* — This species was listed as *Rhaphigaster sulcatum* by Montrouzier and Signoret in Ann. Soc. Ent. Fr., ser. 4, Vol. I, p. 65, 1861, but without a word of description, supposing it to be the same as *Pentatoma sulcata* of Montrouzier. Stal, probably by an examination of the type, discovered that it was distinct and lists it so in the 'Enumeratio' (V, p. 93), and distinguishes it from the species of Montrouzier by its being destitute of the black spots toward the apex of the ventral segments and the brown spots on the base of the venter. I have not yet seen the description by Montrouzier, but believe it very probable that the present specimens belong to the form renamed by Lethierry and Sevrin. The two examples now before me are from the American Museum lot and were taken in Victoria. They are pale olivaceous testaceous with the apex of the scutellum fulvous, the membrane infuscated, and the antennæ fulvous with the apical joint black; the stigmata and tip of the rostrum are also black. The sternal keel reaches the anterior line of the prosternum where it is a little higher. It is a tiny and inconspicuous species when compared with the splendid *Zangis guineensis* from tropical Africa.

Antestia oliva, sp. nov.

(Pl. VIII, fig. 7.)

Allied to *notia* Dallas. Olive green and blackish varied with yellow and obscure orange red. Head yellowish tinged with fulvous with a line on either side of the tylus more or less expanded over the base of the vertex and a spot between the eye and ocellus, black; surface either side of the middle line with irregular large blackish punctures. Antennæ rufopiceous or almost black, basal joint not reaching the base of the head, second and third subequal, fourth longest. Pronotum olive green, regularly and strongly punctured with black, anterior and lateral margins, and sometimes the posterior, narrowly edged with pale; the lateral margins tinged with rufous before the humeri; disk anteriorly with an orange red indefinite spot. Scutellum paler, more closely punctate with black, the base blackish, behind this an oblique orange red ray enters from each basal angle but does not attain the median line, tip pale and impunctate. Elytra pale olivaceous, strongly punctured with black and with a blackish cloud near the inner angle, the costa, at least in part, the apical margin, and a longitudinal calloused ray following the discal nervure and bent inwardly at apex, dark orange red. Membrane fuliginous with the limb pale. Tergum black, narrowly edged with pale. Beneath pale ferruginous yellow tinged with olivaceous along either side, where the surface is sprinkled with strong black punctures, disk and margins of the venter smooth and impunctate. Rostrum reaching the hind coxæ, black at apex. Legs pale, the femora and tibiæ becoming more or less blackish toward their apex, tarsi brown. Length 8 mm., humeral width 5 mm.

Described from two females received from the American Museum, that were taken in New South Wales. This is a very pretty species, with its pale olive surface closely sprinkled with deep black punctures and marked with obscure orange-red on the pronotum, scutellum, and elytra.

Apines geminata, sp. nov.

(Pl. VIII, fig. 8.)

Piceous brown, closely and in places irregularly punctured. Head broad, roundly truncated at apex, the sides rather strongly sinuated before the eyes, lobes of equal length; edges of the cheeks, some vermiculate marks on their disk and the median line of the tylus pale and calloused. Antennæ somewhat clavate, basal three joints slender, fulvous, fourth and fifth thickened, black, fulvous at base; first joint very short, not attaining the apex of the head, second scarcely longer, third and fourth subequal, fifth longest. Pronotum, sides broadly fulvous, anterior and posterior margins very narrowly pale, disk anteriorly with two roundish white impunctate approximate spots. Scutellum with a broad submarginal vitta reaching from the base to beyond the middle, pale and impunctate; apex with a large pale spot enclosing an irregular black mark. Elytra paler exteriorly with a few fulvous reticulations and a whitish subangular spot close to the middle of the apical margin. Membrane fuliginous. Tergum black, edge of the abdomen both above and below broadly rufous with a conspicuous black point at each incisure. Beneath soiled whitish; pleuræ with a double row of black points and there is a similar point on the base of the embolium; venter a little darker toward the sides, the stigmata and the marginal dots already mentioned black. Legs pale, outer edge of the tibiæ with a row of black points and there are three or four larger dots near the apex of the femora. Length 7 mm., humeral width 3½ mm.

Described from two female examples labelled "New South Wales." This species agrees in all generic characters with *Apines concinna* Dallas, but its specific characters are quite distinct. Perhaps the most important of these are the round dots on the pronotum anteriorly and the triangular ones on the apical submargin of the elytra. Dallas's species inhabits India; the addition of the present form extends the range of this genus to correspond with that of the related genera *Antestia* and *Menida*.

Piezodorus rubrofasciatus *Fabricius.* — In the American Museum material are two examples of this species that were taken in New South Wales and in my own collection are three individuals taken by Mr. Dodd at Townsville, Queensland. This species has a wide distribution, having been recorded from Africa, India, and throughout the islands of the Pacific from Java and Australia to Japan and the Hawaiian Islands.

Cuspicona carneola, sp. nov.

(Pl. VIII, fig. 9.)

Rather broad oval. Head and pronotum quite strongly declinate. Fulvous tinged with rosaceous on the scutellum and elytra, and with a band connecting the humeri, the costa at base and the narrow edge and broader tip of the abdomen rosaceous; a geminate spot on the fifth, the narrow edge of the sixth tergal segment, a minute point on the edge of the abdomen at each incisure, and the tip of the rostrum, black. Membrane slightly fuliginous with the base clearer, and with a round fuscous spot near each inner basal angle corresponding to the black tergal spot; beneath paler, apex of the tibiæ and last joint of the tarsi tinged with ferruginous. Stigmata pale. Length 11 mm., humeral width 6½ mm.

The whole surface of this insect is closely, evenly, and rather deeply punctured except the venter which is obscurely aciculate. The punctures on the head are fewer and disposed in transverse rugæ, and those in the transverse frontal band show a tendency to become fuscous. The callosities and an irregular area between the eyes and the small piceous ocelli are smooth. Second and third antennal joints subequal, fourth and fifth longer and a little thicker. Rostrum very slightly exceeding the posterior coxæ. Sternal carina well elevated and rounded anteriorly where it slightly surpasses the emargination of the calloused anterior edge of the prosternum. Ventral spine short and acute, hardly reaching between the posterior coxæ. In the male the apex of the sixth ventral segment is feebly sinuated across the middle and the apex of the genital segment is deeply sinuately emarginate, with the outer angles obtusely emarginate, the valves are long and straight across their apex, the inner plates are narrow and subacute, and the outer plates are very obtusely angled at apex.

New South Wales. This species answers in many respects to Westwood's description of his *Rhynchocoris roei* (Hope Catalogue, I, p. 30, 1837) but he indicates a shorter third antennal joint and omits to mention certain markings it seems impossible he would have neglected. This new species pertains to section "*bb*" of Stal's synopsis in the 'Enumeratio,' V, p. 103.

Cuspicona thoracica *Westwood.* — In the American Museum lot are three examples of this little insect, two from Victoria and one from New South Wales. The broad band of black punctures connecting the acute humeri will distinguish this species.

Cuspicona beutenmülleri, sp. nov.

(Pl. VIII, fig. 10.)

Form and size of *thoracica* nearly, from which species it differs principally in having the hind margins of the pronotum much more deeply concavely arcuated before the base of the scutellum, in wanting the well defined band of black punctures between the humeri, in having the apex of the scutellum broadly pale and nearly impunctate in place of a median apical pale vitta, and in having the venter quite strongly and distinctly keeled, not broadly and roundedly gibbous. The whole upper surface is of a shining testaceous fulvous with large concolorous punctures which become more or less blackish on and behind the humeral horns, across the posterior disk of the pronotum, and on either side of the scutellum behind the middle. The fourth and fifth antennal joints are obviously longer and darker than the preceding while in *thoracica* they are subequal in length; the venter is paler and the broad margins are darker than in its ally, and the intermediate and posterior femora are distinctly punctured with blackish. Length 9 mm., humeral width 6 mm.

Described from one female example in the American Museum taken at Victoria. Although very close to *thoracica* I feel no doubt of its being distinct.

Cuspicona rufispina *Stal.*—Stal described this species from one male example from the Philippine Islands and the American Museum possesses a female from New South Wales that agrees in every particular with this description. In this species the rostrum reaches the base of the third ventral segment; the sternal keel is convexly elevated between the anterior coxæ, before which it is rounded upward, bringing its free apex against the anterior edge of the prosternum; the basal valves of the female genital segment are concavely arcuated either side of their truncated apex, the apical plates are obtuse and abruptly tipped with a minute black tooth as are the apices of the abdominal segments, and the punctuation of the pronotum and venter while large and close is neither deep nor well defined. The punctures of the head show some tendency toward a transverse rugose arrangement anterior to the eyes.

Arvicenna inquinata *Westwood.* — The American Museum material includes one male and three female specimens of this species from New South Wales. At first sight this species is scarcely distinguishable from *Cuspicona rufispina* but on a closer examination may readily be differentiated by its narrower form, the broader impunctate head, the more obtusely rounded latero-anterior margins of the pronotum, the produced posterior pronotal angles, the shorter scutellum, the darker punctures on the pronotum and scutellum, the shorter rostrum, the more straight and produced sternal keel, the smooth venter, and the very different genital characters. The form of the humeri and the colors are practically identical.

Distant founds this genus in his paper on the Pentatomids of the Hope Collection (p. 815), where he also gives a very good figure of it (pl. LIII, fig. 1). Generally speaking it agrees with *Morna*, its nearest ally, in its smooth head, the shape of the sternal keel, and in the produced apical angles of the sixth ventral segment of the female. It differs from Stal's description of his genus *Morna* by the impunctate venter and the obtuse posterior angles of the pronotum.

Birorulus bibax *Breddin.*—Ent. Nachr., XXVI, p. 31, 1900.

(Pl. .VIII, fig. 11.)

Color a uniform ferruginous testaceous, anterior edges of the humeral spines and a spot at the apical angle of each abdominal segment black.

Head long, narrowed toward its apex, the sides nearly straight, cheeks produced before the tip of the tylus, their apex subacute, hardly contiguous; ocelli very near to the eyes; buculæ little elevated, percurrent, becoming evanescent toward the posterior margin of the head. Antennæ: first joint shorter than the head, second a little longer, third at least twice the length of the second, remaining joints wanting. Pronotum strongly declined anteriorly, sides very oblique, anterior margin short, deeply emarginate for the reception of the head, humeral angles produced in long slender very acute and somewhat upturned spines; posterior margin deeply arcuated leaving the posterior angles prominent but obtuse. Scutellum large, passing the middle of the abdomen, apex rather narrow, rounded. Apical angles of the abdominal segments produced in short acute spines. Rostrum long, reaching onto the sixth ventral segment; first joint attaining the base of the head, second scarcely so long as the third but exceeding the fourth. Sternal keel well elevated, rounded anteriorly, its subacute apex attaining the base of the head, closely appressed to the prosternum. Tibiæ terete, subacute at apex. Osteolar canal long, forming an evanescent channel. Median line of the venter smooth and almost keeled, its base produced in a short tubercle which rests in a notch in the posterior end of the sternal keel. Head, pronotum, scutellum, and pleural pieces, closely, rugosely, and confluently punctured; the elytra finely and closely punctured. Membrane with 12 to 14 parallel and straight nervures. Length 20 mm., humeral width 15 mm.

Described from two female examples in the American Museum lot, labelled "New South Wales, 342." This insect goes directly to genus *Pugione* in Stal's synopsis of 1867 but in part five of the 'Enumeratio' he says "Margine postico pronoti subtruncato," which is hardly true of this species. It is a much larger and very different insect from *Pugione flavescens* Haglund. The latter has the humeral angles triangularly produced, head obtuse, tylus percurrent, joints two and three of the antennæ subequal in length; in all which characters it is hardly congeneric with the present species. Dr. Breddin has founded his genus *Birorulus* for this species, placing it near *Rhynchocoris* rather than *Pugione.*

ASOPIDÆ.

Cermatulus nasalis *Westwood.* — The American Museum material contains a series of this common insect from Victoria and New South Wales and from New Zealand and the material in my own collection is from the latter country.

Œchalia consocialis *Boisduval.* — In the American Museum collection is a good series of this species from Victoria, New South Wales, and New Zealand, and I possess several taken at Townsville, Queensland, by Mr. F. P. Dodd in July, 1903.

TESSARATOMIDÆ.

Oncoscelis sulciventris *Stal.* — Two examples from New South Wales are in my collection and another taken in Australia by Professor Koebele is in the National Museum lot kindly sent me for examination by Dr. Howard.

Stilida indecora *Stal.* — The American Museum has one pair of this species from Queensland. The four-jointed antennæ will distinguish this insect from the preceding, which it greatly resembles.

Axona longitudinalis *Westwood.* — I possess two examples of this pretty insect from New South Wales and in the American Museum are two more from the same country.

Lyramorpha rosea *Westwood.* — I have a fully colored male of this species from New South Wales and the American Museum has an obscurely marked female from the same locality.

Plisthenes merianæ *Fabricius.* — Stal includes Australia among the localities for this species but the only specimens I have seen are a few in my own collection that were taken at Obi and the island of Buru.

DINIDORIDÆ.

Megymenum insulare *Westwood.* — A series of this insect, including both young and adults, is in the material taken by Mr. Dodd at Townsville, Queensland. This species seems to want the cupreous reflections so noticeable in *brevicorne*, *subpurpurascens*, *affine*, and *dentatum*, and probably in other species of this genus.

PHYLLOCEPHALIDÆ.

Phyllocephala tumidifrons, sp. nov.

(Pl. VIII., fig. 12.)

Broad ovate; flavotestaceous varied with black. Head large, base of the vertex strongly tumid, tylus nearly vertical; cheeks vertical at base then horizontally expanded before the tylus, subquadrate, distant and straight on their inner margins, their apices irregularly serrated with the outer angles a little rounded off, sides parallel, surface above concave; base expanded and serrated before the eyes with a short acute tooth at the outer angle. Ocelli close to the eyes. Pronotum broad, humeral angles rounded, not at all prominent; latero-anterior margin broadly expanded, reflexed and serrated, almost enclosing the eyes; anterior margin feebly emarginate and elevated on the tumid base of the vertex; behind this is a deep transverse black depression, then a discal transverse carinate line and between the humeri a similar but stronger carinate line; the hind edge straight. Scutellum large, broad and rounded at apex, sides carinated and a little sinuated, the frenus reaching to about the middle; disk with two carinæ enclosing a black vitta. Elytra narrower than the abdomen with the nervures strongly raised, membrane attaining the apex of the abdomen, semipellucid, with fuscous nervures. Upper surface strongly punctate, rugosely so on the base of the pronotum and the scutellum. Pectoral pieces with strong dusky punctures. Venter obscurely papillate, with some indistinct punctures exterior to the stigmata. Antennæ rather short, the second joint hardly surpassing the apex of the head, third and fifth joints a little the longest, the others subequal. Rostrum reaching the intermediate coxæ, the first joint and about one half of the second concealed within the buculæ which are strongly elevated and a little higher posteriorly. Color pale flavotestaceous, the punctures blackish on the sides of the head, expanded margins and base of the pronotum, sides of the scutellum, and in places on the elytra; a spot behind the eye, a broad vitta within the expanded margins of the pronotum, the transverse depression on its disk anteriorly, a median vitta on the scutellum, a geminate median spot on the fifth and sixth ventral segments, a longitudinal vitta on the elytra, tip of the rostrum, the stigmata and a longitudinal vitta on the connexivum, black. Apex of the fourth and fifth joints of the antennæ, inner surface of the femora, extreme tip of the tibiæ, and a longitudinal vitta on either side of the venter and obscurely indicated on the pleura, brownish. Length 17 mm., humeral width 9 mm.

I have two examples of this species that were taken at Rolburne, Northwest Australia, and received by me from Hermann Rolle. It seems strange that this large conspicuous species should for so long have escaped notice. It is quite likely that a new genus will have to be founded for its reception but I do not care to do this now without having had an opportunity of examining the African species already described in this genus. I have included in this description most of the generic characters necessary to locate the species.

ACANTHOSOMIDÆ.

Anischys luteovarius *Westwood.* — One pair of this neat little species is in the American Museum material. They agree in every respect with Westwood's short but excellent description except that the stigmata are not black and there is a round black dot on either side of the third ventral segment at base and a similar one on the metapleura on either side. The present specimens are from Victoria.

Duadicus pallidus *Dallas.* — The American Museum possesses one pair taken in Victoria. The male agrees well with Dallas's description except that the base of the head and front of the pronotum are blackish. The female is a little paler than indicated by Dallas.

Andriscus cinctus, sp. nov.

Pale sea green; head, pronotum before, base of the scutellum, lower surface and base of the femora pale yellowish or tinged with green; base and apex of the antennæ and the tarsi tinged with brownish; base of the scutellum rufescent; slender lateral submargin of the pronotum and elytra and apex of the scutellum black.

Head triangular, apex rounded, surface transversely striated. Pronotum coarsely and sparingly punctured, humeral angles obtuse, not at all prominent; latero-anterior margins straight, carinate, the extreme edge pale; latero-posterior margins quite deeply excavated, posterior margin very feebly arcuated. Scutellum small, sides straight, apex narrow, obtuse, surface coarsely punctured posteriorly. Corium coarsely, sparingly, but evenly punctured. Membrane pellucid. Lower surface almost smooth; ventral spine surpassing the anterior coxæ, green and subacute at apex. Antennal joints subequal, the second and fourth perhaps a little longer. Rostrum attaining the hind coxæ. Apical angles of the sixth abdominal segment subacute. Length 9 mm., humeral width 4 mm.

Described from one female example from Victoria in the American Museum material.

Andriscus terminalis, sp. nov.

Pale yellowish-testaceous slightly tinged with green on the elytra and possibly on the base of the pronotum; apical margin of the elytra broadly sanguineous; antennæ, a small cloud on the anterior margin of the pronotum behind the base of the vertex, costal margin of the elytra and the scutellum obscurely rufofuscous. Apex of the tibiæ and the tarsi a little embrowned.

Head a very little narrower than in the preceding species. Pronotum and scutellum coarsely and rather closely punctured, the latter with a distinct carina behind the middle; elytral punctures rather more distinct, especially on their disk. Ventral spine concolorous, passing the anterior coxæ, a little more slender than in the preceding species. Apical angles of the sixth ventral segment obtuse; pleural pieces and venter quite distinctly rugose. Apex of the genital segment broadly and feebly arcuated. Other characters essentially as in *cinctus*. Length 8½ mm., humeral width 4 mm.

Described from one male taken in Victoria in the collection of the American Museum of Natural History. This insect certainly cannot be the other sex of *cinctus* but like that species it belongs to the group having the humeral angles obtuse and not at all prominent. This group is represented by *bifasciculatus* of Reuter.

Amphaces languida *Stal.* — Victoria, Australia. Two examples are in the collection of the American Museum. As indicated by Stal this species varies from the generic diagnosis of Dallas in having the second and third joints of the antennæ subequal in length.

Edessa vittata Fabricius, which is apparently a common insect in

New Zealand, certainly pertains to genus *Acanthosoma* and not to *Anubis* where it is placed in the Lethierry and Sevrin Catalogue.

Stictocarenus subrufescens, sp. nov.

Ovate, pale testaceous above, margins beneath, antennæ, and tibiæ, more or less tinged with rufous; upper surface strongly and quite closely punctured with sanguineous, these punctures becoming blackish on the base of the pronotum and apex of the scutellum; tip of the third joint and the fourth and fifth joints except at base, extreme tips of the corium, a round spot on the basal angle of the membrane, and median line and tip of the rostrum, black.

Head rather broad, apex rounded, surface finely punctured between oblique rugæ. Second joint of the antennæ longer than the first, more than twice the length of the third; fourth, fifth, and apex of the third a little thickened, minutely setulose; fourth longer than the fifth, subequal to the first which is much thicker and curved. Pronotum broad, latero-anterior margins nearly straight, humeral angles very obtuse, rounded, not wider than the elytra; callosities smooth and pale. Membrane almost pellucid. Buculæ scarcely elevated, reaching almost to the base of the head. Rostrum nearly attaining the posterior coxæ, basal joint much shorter than the head. Osteolar canal long, toward the apex a little curved anteriorly and elevated free from the surface of the metapleura. Ventral spine reaching almost to the intermediate coxæ and overlapping the end of the sternal keel. This keel not greatly elevated, almost straight beneath, feebly rounded between the anterior coxæ before which it projects about half way to the anterior margin of the sternum. Apical margin of the fifth ventral segment strongly sinuated and marked with a conspicuous round impressed black opaque spot on either side interior to the stigmata. Length 11 mm., humeral width 5 mm.

Victoria, Australia. Described from one female example in the American Museum collection. I feel no hesitation in placing this species in *Stictocarenus* although it differs from Stal's diagnosis in having the opaque ventral spot on the arcuated hind edge of the fifth segment and not on the anterior margin of the sixth segment as described by him.

59.57,4(75.6)

Article XII.—DESCRIPTIONS OF NEW SPECIES OF NEUROPTEROUS INSECTS FROM THE BLACK MOUNTAINS, N. C.

By Nathan Banks.

Perla carolinensis, sp. nov.

Head nearly covered by a large black spot, angulate behind in the middle, and leaving a triangular orange spot each side above; an elongate pale spot each side near base of antennæ; basal joint of antennæ mostly black, second joint yellow, beyond brownish; pronotum dull blackish, rather paler on sides; thorax black; abdomen brown, pale below, yellowish toward the tip; setæ dark brown; legs dull brown, darker at tips of the joints and on the tarsi; wings grayish hyaline, venation brown. Thorax but little narrowed behind, angles acute, rugosities not very strong. Wings rather long, radial sector forked two or three times beyond the anastomosis, the first some distance out from the cross-vein. Ventral plate of female reaches scarcely one-half way across the next segment, and is rather deeply emarginate in the middle; the last segment of the male shows a raised, rather transverse white spot, slightly angulate in front.

Length, 32 mm.

Sixteen specimens from Black Mountains, North Carolina, June (Beutenmüller), representing both sexes.

Panorpodes carolinensis, sp. nov.

Pale yellowish; a little black around the ocelli; antennæ black, except joints one and two; legs without dark marks; abdomen dark above on basal two-thirds; tip of the claws of genitalia dark; wings flavescent, with yellowish longitudinal veins and white cross-veins. Face short, triangular, a stout tooth below each eye, extending from the cheek; wings rather narrow, the subcosta runs into the pterostigma; abdomen slender, segments not modified, except the last, which is similar to that of *Panorpa*. The prothorax has four long black bristles above, and there are two on each side of the mesothorax.

Length, 16–18 mm.

Seven males from Black Mountains, North Carolina (Beutenmüller). Agrees with *P. oregonensis* McLach., in many particulars, but has darker antennæ, and the terminal abdominal segment has longer claws, each with a strong basal tooth, and the median piece that projects below, when seen from the side, is shorter, and has a concave upper edge. All the specimens are alike.

Panorpa carolinensis, sp. nov.

Head yellowish, black around ocelli; antennæ brown; thorax brownish yellow; abdomen and legs yellowish. Wings hyaline whitish, with black bands and spots as follows: an apical band, a broad pterostigmatal band, nearly touching the apical at each margin, and with a pale spot on the posterior border, where the band is broader than elsewhere, a large triangular costal spot near middle of wing, and extending almost half-way across it; a broad (not geniculate) sub-basal band, and a costal and anal spot black; venation dark. Wings slender, the subcosta reaches pterostigma in fore wings; in the male the 5th segment has a distinct horn above.

Length, 15 mm.

Five specimens from Black Mountains, North Carolina (Beutenmüller), of both sexes. In one specimen, rather larger than the others, the apical branch of the pterostigmatal band is cut off from the main part of the band. Probably nearest to *P. rufa*, but the wings are less elongate, and membrane not yellowish, nor venation pale in pale areas; the bands are broader, and not geniculate as in that species.

Gœra fuscula, sp. nov.

Maxillary palpi with golden or tawny hairs; antennæ dull black; labial palpi pale on basal part, black beyond; vertex black, golden hairs on the posterior warts; thorax black, some golden hairs form a median stripe on the mesonotum; abdomen dull black; wings uniformly clothed with blackish hairs, venation darker; legs pale brownish, the posterior tibiæ and tarsi paler. Ventral comb of two rather long median teeth, and three each side much smaller. The female resembles the male, but rather larger; the ventral plate is trilobate.

Expanse, 22–24 mm.

Four specimens from Black Mountains, North Carolina, 21 May (Beutenmüller).

Notiopsyche latipennis, sp. nov.

Face gray, with short gray hair; vertex darker, with longer yellowish gray hair; basal joint of antennæ clothed inside with black hairs, longer below; elsewhere with gray hair, rest of antennæ pale, annulate with black, and below with short, erect bristles; prothorax with gray hair above, rest of thorax yellowish; abdomen brown, tip and genitalia yellow; legs pale yellow; wings gray, with yellow-gray hairs, sparse and appressed; along costal margin are longer, darker hairs, pointing back over costal region; venation pale brown; hind wings grayish, venation darker, some scattered yellowish-gray hair on membrane.

Expanse, 20 mm.

One male from Black Mountains, North Carolina, June (Beutenmüller).

Atomyia modesta, sp. nov.

Maxillary palpi dark gray, labial palpi blackish; basal joint of antennæ black, beyond pale, narrowly annulate with dark; head black, gray hairs in front, yellowish above from the warts; thorax brown, yellowish tufts at base of fore wings; abdomen dark brown above, yellowish beneath; legs pale yellowish. Wings gray, sparsely clothed with blackish hairs; venation mostly yellow-brown, fringes dark gray, rather long, especially so on the posterior margins. Preapical pair of spurs on hind tibiæ once and one-half their length before tip; preapical pair of middle tibiæ about twice their length before tip, and nearly as close to base.

Expanse, 14 mm.

Many specimens from Black Mountains, North Carolina, May and June (Beutenmüller).

Arctopsyche irrorata, sp. nov

Head dull dark brown, with some yellowish hair; palpi yellowish; antennæ clear yellowish, basal joint brown; thorax and abdomen brown, pleura yellowish; legs pale yellowish, the tibiæ and tarsi very pale. Wings brown, densely irrorate with yellow, mostly in form of rounded spots, about a dozen of these along the costal region, the brown sometimes forming bands; hind wings gray. Fore wings rather long, the radial sector connected to radius beyond the discal cell, fork 1 with a pedicel one-half its length, fork 3 with a pedicel one-third its length, forks 4 and 5 of about equal length.

Length, 17 mm.

One specimen from Black Mountains, North Carolina, June (Beutenmüller).

Polycentropus carolinensis, sp. nov.

Head densely clothed with yellowish gray hair in front, and blackish behind; palpi pale; antennæ yellowish, very strongly crenate within; prothorax with yellowish hair; rest of thorax and abdomen brown, former with some yellowish hair; legs pale yellowish, tarsi rather darker. Wings uniformly clothed with jet black hair, and with about twenty small snow-white spots, several arranged in an irregular broken band across wing near middle, two at the pterostigma, one or two at posterior apical angle, one at arculus, and two or three on apical margin, those in basal part of wing indistinct; a tuft of erect black hair at base of fore wings; posterior wings blackish, with darker venation; discal cell slender, as long as its pedicel; fork 1 not as long as its pedicel, fork 3 longer than its pedicel, fork 4 reaching basad of fork 3, but with a long pedicel; fork 5 reaching much farther toward base.

Length, 7 mm.

One specimen from Black Mountains, North Carolina (Beutenmüller).

Plectrocnemia auriceps, sp. nov.

Head with much golden hair; palpi yellowish brown; basal joint of antennæ yellowish, beyond dark brown, strongly crenate within; prothorax yellow, with golden hair, and golden tufts on the mesothorax in front; thorax and abdomen brown, margins of abdominal segments narrowly yellowish; legs yellow, hind tibiæ brown. Wings brown, densely marked with patches of golden yellow hair between the veins, which are brown; a larger spot at the arculus; fringe golden, interrupted with brown at the tips of the veins; discal cell not one-half as long as its pedicel, fork 1 not pedicellate, fork 3 with a pedicel not one-half its length; hind wings blackish.

Length, 14 mm.

One male from Black Mountains, North Carolina, June (Beutenmüller).

59.82(57.1)

Article XIII. — REPORT ON THE BIRDS COLLECTED IN NORTHEASTERN SIBERIA BY THE JESUP NORTH PACIFIC EXPEDITION, WITH FIELD NOTES BY THE COLLECTORS.

By J. A. Allen.

This is the second of a series of papers on the zoölogical results of the Siberian Division of the Jesup North Pacific Expedition. The first article, relating to the mammals, was published in this Bulletin, in 1903 (Vol. XIX, pp. 101–184, and pp. 195, 196, March 31 and May 9, 1903). The collection of birds, like the collection of mammals, was made chiefly by Mr. N. G. Buxton, but many specimens were presented to the Expedition by Mr. Nicoli Polowitch Sokolnikoff, Governor of the Anadyr District, with headquarters at Marcova. He also gave to Mr. Buxton important field notes on the birds occurring in the vicinity of Marcova, which are incorporated in the present paper.

As Mr. Buxton's itinerary and general description of the country has already been published in full in the report on the mammals (*l. c.*, pp. 104–119), it is unnecessary to republish any part of it here.

The collection of birds contains 800 skins and a number of nests and eggs, all of which were collected by Mr. Buxton except about 50 specimens from Marcova, and about 170 from the head of the Gulf of Anadyr presented by Mr. Sokolnikoff. Mr. Buxton's bird skins (about 580 in number) are all beautifully prepared, and are in every way first-class material; the others are quite roughly made, but are nevertheless an important and most welcome addition to the collection, including, as they do, quite a number of species not obtained by Mr. Buxton. On a trip made by Mr. Buxton from Vladivostok to Lake Kanka, mainly for fishes, a few birds were taken, representing four species (*Hydrochelidon leucoptera*, *Jynx torquilla*, *Alauda intermedia*, and *Uragus sibiricus*) not met with by him at Gichiga, where he collected from August 19, 1900, till October 4, 1901. Respecting his bird work at Gichiga and the character of the country in which his collection was made, he has kindly furnished the following important information:

"All of the birds in the collection labeled 'Gichiga' were collected within a radius of 35 miles from my station at Kooshka, which is situated on the left bank of the Gichiga River in latitude 62° 42′ E. The greater part of them were collected within a radius of 10 miles.

This larger area, and even the smaller one, was quite diversified in its physical features. It included low barren mountains, foothills, and high, rolling tundra dotted with small lakes; low, moist tundra, marsh land, and mud flats; river bottoms filled with larch, willow, and alder; high, rugged seacoast, rocky islets, and shingle beach. With the exception of a few species, bird life is not abundant in this region, and many species evidently appear there only as stragglers or as transients. As at any place in the high north, birds are abundant only during a few weeks in spring and fall, while migrating, and during the summer they are not even common. Roughly speaking, May 1 may be put down as the beginning of the spring migration, September 1 as the beginning of their return from further north, and October 1 as the close of the fall migration.

"The Russian people at Gichiga are very ignorant and poor observers. They have definite names for only a small per cent. of their native birds. Nearly all the small land birds are called *P'teet-ish-ka*, the diminutive of *P'teet-sah*, meaning bird. The larger shore birds are called *Koo-leek*, and the smaller ones, including the sandpipers, and also the phalaropes, are called *Koo-lich-kah*, the diminutive of *Koo-leek*."— N. G. B.

With the bird skins from Marcova, presented by Mr. Sokolnikoff, is a list of the species, with brief field notes by him, and also a supplemental list of birds known to him to occur at Marcova, but of which there were no specimens in his collection. These notes, in cases where the identification of the species seemed beyond question, have been utilized in the following paper. Of this gentleman, Mr. Buxton says:

"Mr. Sokolnikoff is a very intelligent and highly educated man, an officer of the Russian army, who had been in charge of the post at Marcova for four years, and who was greatly interested in the fauna of that region. While the information I received from him was meager, owing to my inability better to understand Russian, still it is, together with the specimens, of much value in making up a list of the birds of that district."

Mr. Buxton's field notes on the species of birds taken or observed by him are given in marks of quotation, followed by the initials N. G. B. Mr. Sokolnikoff's notes are similarly distinguished, and are followed by the initials N. P. S. There are no notes beyond the locality and date of collecting with the specimens from Novo Marinsk. Great credit is due Mr. Sokolnikoff for interesting himself so deeply in the ornithological work of the Expedition and adding so materially to the collection of birds. The specimens from Novo Marinsk were transmitted through Mr. Waldemar Bogoras, one of the ethnologists of the Expedition, and those from Marcova, as above stated, through Mr. Buxton.

The number of species represented in the collection is 125, of which two—an *Alauda* and an *Anthus*—appear to be not heretofore described. Two species, a Swan and a Swift, are included on the basis of Mr. Buxton's notes, making a total of 127 species here recorded. Respecting many of them, Mr. Buxton's field notes are very full and satisfactory, adding much first-hand and original information respecting the ornis of the lower Gichiga River, and forming the first standard, though, of course, more or less incomplete, list of the birds of a single definite locality in Northeast Siberia.

1. **Colymbus holbœllii** (*Reinhardt*). — Two specimens: Gichiga, male, June 8; Marcova, immature, August.

"A very rare bird at Gichiga, this being the only one observed. The residents here have seen it before, but report it as very rare."— N. G. B.

"Rare at Marcova; probably breeds, as young have been seen in August." — N. P. S.

2. **Colymbus auritus** (*Linn.*). — One specimen, in immature or winter dress, Gichiga, August 27.

3. **Gavia adamsi** (*Gray*). — Two specimens, and the head and feet of another. The head and feet are those of a young bird, labeled Marcova, September 1. The other specimens are from Post Novo Marinsk, head of the Gulf of Anadyr.

"Yellow-billed Loon. Russian local name, *Gah-gár-ee*. The Russians say that there are three species of Loons found at Gichiga. Besides the two represented in the collection, there is also a very large one with a white bill. It is very rare and occurs only in spring and fall. I saw none." — N. G. B.

4. **Gavia arctica** (*Linn.*). — Ten specimens: 2 adult males, 5 females, and a young bird still retaining most of the downy first plumage attached to the tips of the growing feathers of the second plumage. All but two were taken at Gichiga, as follows: June 24, August 1, September 4, 16, and 19, and October 2. The young bird still in the downy plumage was collected September 16, indicating a late breeding date. Two specimens, adult, from Marcova.

"Russian local name, *Gah-gár-ee.* Common fall migrant and summer resident. I saw none of these during the spring of 1901, but in the fall of 1900 and 1901 they were common. In 1901, they first appeared on the river, July 31, and soon became abundant in the lower portion of it near its mouth. On September 23, I saw there a flock of 50, and on October 1 a flock of 30. During the first of August, while goose shooting on the large lakes down the mainland coast, I saw many of them. They nest about the larger lakes, which are found further inland. They disappear entirely by the last week in September. A very few nest near Kooshka. One young was taken there, August 30, 1900, and another September 19, 1900." — N. G. B.

"Common at Marcova; breeds." — N. P. S.

5. **Gavia lumme** (*Gunn.*). — Ten specimens: 2 adult males, 1 young male, and 4 females, Gichiga, May 18 and 19, June 5, August 27 and 30; 2 adults, Marcova, May 30; 1 adult, Novo Marinsk.

"Red-throated Loon. Russian name, *Gah-gár-ee.* Abundant summer resident. First birds arrived May 16; became abundant by May 24. The first birds are seen on the tundra pools, as they arrive before the river is open. After it is clear they are common on the river for a week or ten days, when they move to the tundra lakes and pools and prepare for nesting. Two sets of three eggs each, were taken June 19; the nests were placed on small islets or bunches of grass in the lakes. By the latter part of July they are again common on the river, where they remain until the latter part of September, when they all disappear. There is scarcely a moment, day or night, from the time they arrive until they depart, that one cannot see one flying up or down the river or over the tundra, uttering its goose-like cackle, or hear its weird, dismal notes from the river or tundra lakes." — N. G. B.

6. **Lunda cirrhata** (*Pallas*). — Five specimens, of which 4 (2 males and 2 females) are from Gichiga, June 12, and 1 from Novo Marinsk, head of the Gulf of Anadyr, June 15.

"Tufted Puffin. Russian name, *Tō-por-óky.* An extremely abundant summer resident, breeding in suitable places in immense colonies. The first arrivals appear during the first week of May, although they do not become abundant before the 15th of May. They do not come further up the coast than Matuga, 12 or 15 miles south of the mouth of the Gichiga River.

"The largest island at Matuga is situated about one mile off the point and rises precipitously on all sides to a height of two to three hundred feet. On its eastern, southern, and western sides, where it is exposed to the wash of the sea, it rises perpendicularly, and its top is not accessible from these sides. But on the north side, which is also very steep, a little soil covers the crumbling rocks so that one can ascend it with difficulty. It is composed of metamorphosed shells, seamed with quartz and basalt, and on top of it, imbedded in the soil, are found snail and mussel shells that cannot be distinguished from those now living in the water below. The top of it is covered with a deep, black soil on which is a luxuriant growth of grass and plants the same as found on the mainland. Close to the edge where this soil has slipped off into the sea, the Tufted Puffins dig holes in the black earth and there deposit and hatch their single egg. Every crevice in the small loose rocks on the north side is also occupied. The island is about one half mile long, and varies in width from a few yards to two hundred. Numerous gulls and shags also nest in the more accessible places, but not one Horned Puffin is found on the entire islet. At the report of a gun the birds fly out over the water in such numbers as almost to darken the sun, and the noise they make is indescribable.

"The Koraks and the Russians from Gichiga visit this place every year and collect the eggs. The Koraks are very fearless eggers and obtain large numbers. The height of the nesting season is the second week in June when most of the eggs are fresh. The Puffins leave about the middle of October, although some remain later. Puffins are eaten by the Koraks and Russians, and are considered equal to ducks." — N. G. B.

7. **Fratercula corniculata** (*Naum.*). — Eight specimens, of which 1 is from Gichiga, July 23, and 7 from the Alooshka River, near Novo Marinsk, head of the Gulf of Anadyr (Sokolnikoff, June 2).

"Horned Puffin. Russian local name, *Tō-por-óky*, in reference to its bill resembling an ax blade.

"A few nested in the cliffs below the mouth of the Oveche River, and they were quite common along the coast from this place down to Chaibook Point. At Matuga Island, where the Tufted Puffins nest in such vast numbers, this species is entirely absent. The Cossacks said that further down Taiganose Peninsula they were abundant. They arrive the latter part of May and remain until the end of the first week in October."—N. G. B.

"Abundant in the Gulf of Anadyr, where they breed." — N. P. S.

8. **Cepphus carbo** *Pallas.* — Two specimens, males, Gichiga, June 10 and 17.

"Spectacled Guillemot. Quite common along the coast of the Taiganose Peninsula south of Chaibook Point, where I saw them swimming in the water close in shore or sitting on the rocks near the water. They breed there, although I saw none of their nests. They have a sharp, squeaky note, similar to that of the auklets. I saw them every day from June 10 to 17, 1901, but had no other opportunity of visiting their resorts. It is not unlikely that they winter there, as the water is more or less open all winter." — N. G. B.

9. **Uria lomvia arra** (*Pallas*). — One specimen, Novo Marinsk, June 13.

"Pallas's Murre. Russian local name, *Ahr'-rah.* I saw a few at Chaibook Point and Matuga Island during the second week of June, 1901, and the Cossacks who were with me said that it was extremely abundant further down the coast of Taiganose Peninsula, where it nested, and that they had collected its eggs there." — N. G. B.

"Auklets. — One or more species of Auklet will probably be found breeding along the southern portion of Taiganose Peninsula and along the western coast of Okhotsk Sea in the Gichiga region, as I saw many at sea half way between Gichiga and Ola on September 10, 1901. As I had no glass I was unable to identify them." — N. G. B.

10. **Stercorarius pomarinus** (*Temm.*). — Two specimens, Novo Marinsk, head of Gulf of Anadyr, June 10.

11. **Stercorarius longicaudatus** *Vieill.* — Three specimens: Gichiga, June 4; Marcova, May 1; Novo Marinsk, head of Gulf of Anadyr, July 18.

"Long-tailed Jaeger. Russian name, *Res-boy-nick*, meaning robber. This specimen was killed by a Cossack on the tundra above the settlement of Gichiga, where it is said to breed sparingly. On May 25, 1901, I saw one flying northward over the tundra at Kooshka, and on August 10, while down on the mainland coast, I saw two." — N. G. B.

12. **Larus glaucus** (*Brünnich*). — One specimen, an immature female, taken at Gichiga, October 9.

"Glaucous Gull. Russian name, *Chái-kah.* During the first week of October, 1900, I saw one of these large white gulls along the river several different times, tormenting the old squaws or sitting on the gravel bars." — N. G. B.

13. **Larus schistisagus** *Stejneger*. — Thirty specimens, of which 17 (7 males, 10 females) are adult, and 13 immature, varying in age from a single specimen partly in downy first plumage to birds beginning to acquire the dark mantle. They were all collected at Gichiga as follows: 17 in May, 2 in July, 5 in August, and 6 in October.

"Russian name, *Chái-kah*. This is the most conspicuous and one of the most abundant birds along the Okhotsk Sea. From the time of its arrival until it departs there is scarcely a time when one cannot either hear or see one or more of these birds. The first arrivals are usually reported about the 20th of April, and from that time on they increase in numbers daily until May 1, when they have nearly all arrived. From the time of their arrival until the nesting season begins, they make daily excursions up the rivers in the morning and return to their roosting places along the seacoast in the evening. They go up the Gichiga River at this time as far as Christova, 30 miles above its mouth. Also at this time many may be seen soaring in large circles high over the tundra and marsh above the mouth of the river, when they utter a cry very similar to that of the Red-tailed Hawk during the breeding season. None of the dark phase are seen among the earlier arrivals, but by the 15th of May they begin to appear and increase in numbers until they have all arrived, although at no time during the spring and early summer do they form any considerable per cent. of the thousands that one sees. Before the ice goes out of the head of the bay and river, their food supply is limited to the few dead salmon which the melting snow exposes on the gravel bars along the river beds, and the mussels they pick from the rocks along the seacoast at low tide.

"By the first of June, all of the breeders have repaired to the rugged seacoast and rocky islets lying off it, below the mouth of the river, to breed. Only the roughest and most inaccessible places are chosen for nesting sites, generally at the headlands where sections of the solid rocks have been partly or wholly separated from the mainland. The nests, which are loose, bulky structures, composed of grass and with but a slight depression in the center, are placed on ledges and the tops of rocks. Three eggs constitute a set, and they show the usual large variation in color and size found in the eggs of other species of *Larus*. The height of the nesting season is reached about June 10, when the Koraks visit their rookeries and obtain large numbers of their eggs by being lowered down the cliffs with sealskin lines. Many more breeders spend the summer on the bars and along the marsh near the mouth of the river, and on the gravel bars along its bed. After the nesting season is over, about the first of August, the breeders and young of the year join the non-breeders and they all spend the rest of the season in flying up and down the river, collecting in large flocks along the water front, and gorging themselves on the worn-out salmon that they find there. At this time they begin to fly up the river at two or three o'clock in the morning, continuing to fly until the middle of the forenoon, and then begin the return flight at 5 P.M. and continue to fly until long after dark, which does not occur at that time until 10 or 11 P.M. They are so abundant that on these flights there is one continuous long, loose flock of them without any considerable break or intermission. The height of the return flight is from 6 to 8 P.M. When the wind is strong they fly high, but when it is calm they fly low and are easily attracted. When one is killed on the wing, or a decoy is thrown into the air, all the gulls in the vicinity will immediately 'land about' and circle once or twice over the dead bird or decoy, changing their usual guttural cackle to hoarse 'squeals' of alarm before proceeding on their way. I have often seen them attempt to take a fish from the mouth of a seal, when it arose to the surface, and which the gull had been watching catch the fish. By the last of August, one dark or young one is seen to every four or five adult or white ones, and later the proportion of the dark ones is much higher, as the adults begin to leave first. By the first of October, the migration is well advanced, and decreases daily until the by 15th of October few remain, although the last of them do not leave until the last week of the month. They are the last of the migrants to leave in the fall.

"The residents say that many nest on the tundra, and have brought me eggs saying that they were taken on the tundra; and I have seen many of the gulls on the tundra during the nesting season which appeared to be breeding there, but I never found any nests." — N. G. B.

14. **Larus argentatus** *Linn.* — Three specimens, 2 adult and 1 immature, Novo Marinsk, Gulf of Anadyr.

15. **Larus canus** *Linn.* — Twenty-seven specimens, of which 26 are from Gichiga and 1 from Marcova. Seven are adults in breeding dress, 11 are adults in fall plumage, and 9 are birds of the year. Two

of the Gichiga specimens were taken May 1, 2 in June, 1 in July, 19 in August, and 1 each in September and October. They form a fine series of beautifully prepared skins.

"Russian local name, *Gov-o-roós-ky.* Not an uncommon spring migrant and summer resident, and common fall migrant. A few arrive at Kooshka during the latter part of May, and are seen in company with the larger gulls, which remain along the river all summer. On June 6, 1901, I saw a pair about a tundra lake in which there were several small grass-covered islets, and on June 24 I collected both of them (Nos. 841 and 842). They were evidently nesting there, although I could find no nest. They do not nest with the large sea-gull along the seacoast. About the middle of August they become common along the river and associate with the large gulls until they leave—the middle of September. When feeding they hover over the water and drop into it, keeping the wings extended while on the water, and then arise with the greatest ease." — N. G. B.

Marcova: "Arrives May 1; not common." — N. P. S.

16. **Larus ridibundus** *Linn.* — Seven specimens, apparently all birds of the year, taken at Gichiga, August 18–21.

"First appeared on the river, August 18, 1901, opposite my station, where they were feeding in the rapid water, hovering over and dropping into it like terns. From this time on, for about one week, they were common there and down at the mouth of the river. The Russian residents say that they are common down the seacoast about the last of May and the first of June, but do not remain during the summer. They are all gone from the river by September 1." — N. G. B.

17. **Xema sabinii** (*Sabine*). — One specimen, in breeding plumage, Novo Marinsk, head of Gulf of Anadyr.

18. **Sterna paradisæa** *Brünn.* — One specimen, Marcova.

19. **Sterna camtschatica** *Pallas.* — Nine specimens, 5 adult and 4 immature, taken at Gichiga, August 17–20.

"May 27, 1901, I saw a flock of 200 or more flying down the river high in the air. May 28, 1901, I saw a large flock feeding on the river just below my station (Kooshka), but I saw no more until I visited Christova, 30 or 35 miles up the river, the second week of July, when I observed perhaps 10 flying up and down the river and sitting on the large gravel bars at that place. During the third week in

August they were common on the river opposite my cabin, feeding in the rapid water at that place. The Russians say that they are common, and are well acquainted with them. There are no sandy beaches around the head of the Okhotsk Sea suitable for them to nest on, and it is probable that they nest on the sand and gravel bars along the upper reaches of the Gichiga and Ovecho Rivers." — N. G. B.

20. **Hydrochelidon leucoptera** (*Meisner & Schinz*). — One specimen, adult female, Lake Kanka, June 1.

"This handsome tern is very active late in the afternoon and evening, when it flies in large flocks over the low marshy places along the lake front where there are low willows. During the earlier part of the day it is not seen. It is less noisy and much shyer than the Arctic Tern [= *Sterna camtschatica*, as shown by his notes], which is also here. Nests on sandspits along the lake south of here." — N. G. B.

21. **Puffinus tenuirostris** (*Temm.*). — One specimen, Novo Marinsk, head of Gulf of Anadyr.

22. **Phalacrocorax pelagicus** (*Pallas*). — Eight specimens: six from Gichiga, in breeding dress, with the white neck and back plumes, May 13 and June 12; one adult from Marcova in moult, and an immature specimen from Novo Marinsk, Gulf of Anadyr.

"Russian name, *Oō-rél-y*. Arrives by the end of the first week in May, and the last of them depart by the second week of October. Very abundant along the rocky coast of Gichiginski Gulf. They are also abundant along the mainland coast at least as far south as Ayan. They do not come up the Gulf further than Chaibook Point, six miles south of the mouth of the Gichiga River. At this place, and six miles further south, at Matuga Point, there are several rocky islets with precipitous sides where thousands of them nest. Their nests are placed in the most inaccessible places on top of ledges and projections. The nests are large and bulky and composed of kelp and sea-weed. The eggs are chalky-white, with a bluish tinge. Five to seven constitute a clutch. The eggs are not palatable on account of the strong flavor, although the Koraks gather and eat them. The height of the nesting season is reached by the 10th of June. The males assist in the work of incubation. Both No. 835 and No. 836 (males) were shot on nests, and one more male, not in the collection." — N. G. B.

23. **Merganser serrator** (*Linn.*). — Five specimens: 4 from Gichiga, June 4, September 19, and October 5; one from Marcova, without date.

"Not an uncommon spring and fall migrant, arriving the middle of May and departing by the end of the first week in October. During the spring and fall a few pairs or small flocks may be seen flying up and down the river or resting upon it. I saw a few single birds and pairs flying up the river during the first week of June, and one single bird, July 10, 1901, at Christova, in the wooded country thirty miles up the Gichiga River. It is said to breed further inland." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

24. **Mergus albellus** *Linn.* — Three specimens: 1 female, Gichiga, May 3; 2 males, Marcova, May 18.

"This duck, the first of the season to arrive, I killed on a small pool of water near my station, May 3, 1901. This is the only one I saw at Gichiga, and it was unknown to the Cossacks." — N. G. B.

Marcova: "Common; breeds. Arrives latter part of May." — N. P. S.

25. **Eunetta falcata** (*Georgi*). — One specimen, an immature male, Gichiga, October 7.

"Rare at Gichiga. This single specimen was taken from a small flock, on one of the chain of tundra pools on the low tundra along the water front." — N. G. B.

26. **Mareca penelope** (*Linn.*). — Six specimens: 2 males and 1 female from Marcova, May 12; and 1 adult and an immature pair from Gichiga, May 4, August 27, and September 9.

"This was the second species of duck to appear at Gichiga in the spring of 1901. Near my station, on the morning of May 4, I killed one and winged another, and secured two in the fall. Reported rare; I saw very few." — N. G. B.

Marcova: "Common; breeds."—N. P. S.

27. **Nettion crecca** (*Linn.*). — Fifteen specimens: 6 adult males, 2 young males, and 7 females—of which 12 were taken at Gichiga, May 21–26, August 27, and September 6; 3 at Marcova, May 12 and 30.

"Russian local name, *Chee-róke.* The most abundant representative of the ducks at Gichiga. Begins to arrive just after the middle of May (17th) and soon becomes common on the tundra pools, where they remain until the river opens, to which they then resort. By the end of the first week of June most of them have paired and begun nesting on the tundra. The nest is made of grass and lined with feathers, and placed in the vicinity of a pool on the moist tundra. Many go further north to breed, and these reach Gichiga on their return about September 1. After the breeding season they repair to the river and the chain of pools near its mouth, where they remain until the middle or latter part of September." — N. G. B.

Marcova: "Not common; breeds." — N. P. S.

28. **Nettion formosum** (*Georgi*). — Three specimens: male and female from Gichiga, May 19 and 21; male from Marcova, without date.

"Rather common in spring and fall, and a few probably remain and breed, although I saw no nests. They begin to arrive in pairs about May 19, when they are found on the tundra pools until the river opens, the latter part of the month, which they frequent until they move on about the middle of June. They are again seen on the river and tundra pools about the first of September, but do not remain long. This bird is confounded with the smaller teal by the residents, which is abundant."— N. G. B.

29. **Spatula clypeata** (*Linn.*). — Three specimens, Gichiga, May 24, June 17, and September 17.

"Not common and rarely if ever seen in flocks, but singly and in pairs. Arrives middle of May and departs latter part of September. Observed at Gichiga only in spring and fall. Probably breeds in the vicinity, although I saw none during the summer. When resting on the tundra pools they have a peculiar *clack-clack-clack-clack*, unlike the sound made by any other duck here." — N. G. B.

30. **Dafila acuta** (*Linn.*). — Eighteen specimens: 4 adult males, 3 immature males, 2 females, and 6 half-grown young, all from Gichiga, collected May 17–21, July 19 (brood of six young), August 1 (in moult), 29, and 30, and September 7; a pair from Marcova, May 14· a female from Novo Marinsk, head of Gulf of Anadyr.

"Russian local name, *Vwos-tro-whost'*. Next to the teal [*Nettion crecca*], this is the most abundant duck. The first pair arrived May 8, and in a few days they became common on the pools. Later they were common in pairs and small flocks on the river, but all left there for the tundra by the middle of June, where they nested. About the middle of August they collect in flocks and may be seen during the morning flying up the river, high overhead, and returning in the evening to the sea and the chain of pools along it. The young are seen on the pools the latter part of July. They begin leaving in August, the males going first, and all are gone by the latter part of September. Those from further north arrive about September 1." — N. G. B.

31. **Aythya marila** (*Linn.*). — Fourteen specimens: Marcova, 3 specimens, May; Novo Marinsk, 1 specimen, May 12; Gichiga, 10 specimens, June 8 (male), and 15 (female), July 19, 2 females and 7 young, a few days old, in the first downy plumage.

"Shot on a slough near my station, May 26, 1901. The residents say that it is very rare. One of the fattest birds that I ever prepared; requiring two and a half hours. Nos. 912 and young (Nos. 913 to 919, inclusive) were taken on one of the chain of tundra pools along the water front, August 19, 1901." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

32. **Aythya fuligula** (*Linn.*). — One specimen, adult male, Gichiga, May 23.

"Very rare; unknown to the Russian residents. Saw but the one, which I killed on a small tundra pool." — N. G. B.

33. **Clangula clangula** (*Linn.*). — One specimen: female, Gichiga, October 19.

34. **Harelda hyemalis** (*Linn.*). — Thirteen specimens: Gichiga, 1 adult male, July 28; Marcova, 5 males and 2 females; Novo Marinsk, 3 males and 2 females.

"Old Squaw. Russian local name, *Sáhf-kah.* An abundant spring and fall migrant, and a few remain all summer and probably breed, although I found no nests and saw no young. They first appeared in the open places in the river, May 22, but they had probably been outside on the sea some time before that date. After the river cleared of ice, May 26, they were abundant on it and remained there in large numbers during June, flying up and floating down and feeding in the quieter places below the gravel bars. A very few remain there and along the seacoast all summer. About the middle of September they begin to return to the river, are again abundant by the 30th, and from that time on until they have all gone, October 16, one can hear their *Ah-áh-linck*, or see them almost every day." — N. G. B.

Marcova: "Abundant; breeds." — N. P. S.

35. **Histrionicus histrionicus** (*Linn.*). — Five specimens: Gichiga, 1 male, June 10; Marcova, 2 males, May 17; a pair, Novo Marinsk, May 29.

"Harlequin Duck. Not rare. A very few are seen along the lower river, and more about the tundra pools. Along the rocky coast south of the mouth of the Ovecho River, they are not rare, and some are also found far up the river, where they are said to breed." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

36. **Polysticta stelleri** (*Pallas*). — Three specimens: an adult male, Gichiga, June 10 and July 1; 2 adult males, Novo Marinsk, May.

"Steller's Duck. A single specimen taken from a flock of twelve, just outside the mouth of the Gichiga River, June 10, 1901. The Cossacks had no name for it, and said that they had never seen one before. However, it is probably common in spring and fall, but stays outside on the Gulf, so that it is seldom observed." — N. G. B.

Marcova : "Rare."—N. P. S.

37. **Somateria mollissima** (*Linn.*). — Seven specimens: Gichiga, 2 adult males, June 8, 2 adult females, July 17 and October 14, and 3 newly hatched young, July 14 and 16.

"Russian local name, *Bah-oó-lah.* Tolerably common summer resident. They first appear in pairs or in small paired flocks, flying up and down the river a few days before it breaks up, the last week of May, and as soon as it clears of ice they begin making trips up the river. The males of those pairs that remain to breed leave by the latter part of June and are seen no more, at least on the river. I saw sixteen males out at sea, September 7, 1901. By the 1st of June they have begun nesting, and few are seen along the river until the middle of July, when the females collect in flocks of from six to thirty, and spend their time on the gravel bars along the lower river, and along the sea coast near the river's mouths. Nests are built in the vicinity of the tundra pools, and the young are hatched the latter part of June and first of July. All have gone by the third week of September. Two specimens (Nos. 817 and 818) together weighed eleven and three quarter pounds, and neither was extremely fat." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

38. **Somateria v-nigra** *Gray.* — Four specimens: adult male and

female, Novo Marinsk, June 1; adult male and female, Indian Point, May 28 and June 6.

39. **Somateria spectabilis** (*Linn.*). — Three specimens: adult male, Gichiga, June 10; 2 males, Indian Point, May 19.

"On the morning of June 10, 1901, while beating down the rocky coast along the Taiganose Peninsula, in a leaky river boat, a mixed flock of seven Pacific Eiders and two male King Eiders flew over our boat, when I killed this specimen. None of the five Cossacks with me had ever seen the species before and called it a 'droo-goy bah-oo-lah,' or an Eider different from the Pacific, which is the only one that they are acquainted with. These were the only two that I saw on the Okhotsk Sea. Mr. Sokolnikoff says that it is common at Marcova, where it breeds, and is abundant at the mouth of the Anadyr River in the spring and fall." — N. G. B.

40. **Oidemia nigra** (*Linn.*). — Five specimens: an adult male and a young bird in downy plumage from Gichiga, July 27 and August 8; and 3 males from Novo Marinsk, May 26 and June 30.

"Black Scoter. Russian local name, *Chor'-na-oót-kah.* Not uncommon. First makes its appearance at Kooshka just after the river clears of ice, flying up the river singly and in flocks of two or three at high tide and returning as the water goes out. A few remain all summer and breed about the tundra lakes lying along the mainland coast. First record of them, June 7, 1901; last, August 29, 1901.

"This species and the White-winged Scoter are said to breed in large numbers about an old lagoon near Yamsk, and, while moulting in August along the seacoast, the natives surround them in canoes and kill them with clubs." — N. G. B.

41. **Oidemia fusca** (*Linn.*). — Three specimens: a pair of adults from Gichiga, June 8; and a male from Marcova.

"White-winged Scoter. Russian local name, *Tour-pon'.* Not uncommon. The notes on the Black Scoter will apply to this species, which is, perhaps, a little more common." — N. G. B.

Marcova: "Common on the river in summer." — N. P. S.

42. **Anser fabalis middendorffi** (*Severtz.*). — Six specimens: Gichiga, adult male and female, May 12 and 17; Marcova, adult male (?), May; Novo Marinsk, 2 adults and 1 young in the first downy plumage.

"White-fronted Goose. Russian local name, *Kah-sark-kah.* Very abundant spring and fall migrant, and a limited number remain during the summer and nest. The first birds are usually seen about the first of May, although their arrival is hastened or delayed by the condition of the snow and wind. An early season and southerly winds will bring them several days earlier, and the reverse will delay them an equal length of time. From this time on until the first of June more or less are seen every day, although there are only a few days when really large flights occur. These large flights take place during the early morning, or at night from 5 P.M. until 11 or 12 P.M., when there is a southerly wind, or on the day following one. They come in from over the sea, fly low over the lower tundra, and continue northward up the valley or over the high tundra, where some remain to feed on the blossoms of the bunch grass before passing on. A few stop on the marsh along the water front or return there at night to feed. On May 16, 1901, there was a very large flight which lasted all day, when I counted as many as 15 flocks in sight at one time, and some of them contained more than 200 individuals each. The average size of a flock is eight or nine. By the end of May the migration is over, and those that have remained to nest have moved inland and scattered out among the tundra lakes to breed. A set of eggs was brought to me, June 16, 1901. The latter part of July, they congregate on the large lakes inland and moult. As they are unable to fly at that time, the Russians organize hunting parties and visit these lakes, when they shoot many of them. I joined such a party at the beginning of the second week of August, but we were about ten days too late, and got only a few. We saw flocks of nearly 200 on some of the very large lakes, but were unable to reach them, as we had no canoe. The Tunguese visit these places with canoes and obtain hundreds.

"The birds from the north reach Gichiga on their return, September 1, and continue to pass until the first of October. In the fall many stop on the marshes along the head of the bay and feed and rest for a time before continuing southward.

"Some of the best hunters at Gichiga kill as many as 70 on the spring migration and nearly as many in the fall, which they salt and use during the long winter." — N. G. B.

43. **Anser albifrons gambeli** (*Hartl.*). — Six specimens: Gichiga, 2 adult males and 1 adult female, May 16 and 20; Marcova, 1; Novo Marinsk, 2, May 19 and 25.

"Russian name, *Goo-may'-nick.* A little less abundant than the preceding, with habits practically the same. Not so many remain to breed." — N. G. B.

Marcova: "Breeds near the seacoast." — N. P. S.

44. **Philacte canagica** (*Sevast.*). — Four specimens, Novo Marinsk.

45. **Branta nigricans** (*Lawr.*). — Five specimens: 4 from Novo Marinsk and 1 from Indian Point.

"Black Brant. Russian local name, *Nee-mock'*. The Russians described this bird to me perfectly, and said it was very rarely seen at Gichiga, but was common at Ola, Okhotsk, and Marcova." — N. G. B.

46. **Olor** sp.? No species of swan is represented in the collection; hence the species mentioned below as "*Olor cygnus*" cannot be determined. Sokolnikoff, in his notes on Marcova birds, as transmitted by Mr. Buxton, gives two species, as follows:

"*Cygnus musicus.* Common, breeds"; and "*Cygnus bewickii.* Killed two and saw five."

"*Olor cygnus* [?=*Olor bewickii* Yarrell]. Whooping Swan. Russian name, *Lle-bed* (*ĕ*). One of the earliest migrants to arrive. One was killed on the upper Gichiga River, April 1, 1901, and they were common there by the last week of that month. They breed there. Near Kooshka, I saw seven on May 1; three on June 7; four on June 10, and one was killed at Gichiga, August 10, 1901." — N. G. B.

47. **Crymophilus fulicarius** (*Linn.*). — One specimen, male, Marcova, June 21.

Marcova: "Abundant; breeds." — N. P. S.

48. **Phalaropus lobatus** (*Linn.*). — Thirty-eight specimens: 35 from Gichiga and 3 from Marcova. Of the Gichiga specimens, 29 are adults in breeding plumage (males and females), and were taken May 29 to June 19, and 1 (in moult), August 27; 6 are young or adults in fall dress, and were taken August 1 to 4, and August 23 (1 specimen). The 3 Marcova specimens (breeding birds) were taken May 13 and 22.

"Northern Phalarope. Abundant summer resident. Begins to arrive the last of May, and is common on the tundra pools by the end of the last week in June. Eggs are deposited by the first of June. The nest is a depression in the moss or grass, near a pool, lined with a little grass. About the last of July they collect in small flocks of three to ten on the pools, where they remain to feed until they leave in the fall. When feeding they turn and spin about on the water and nervously jerk their heads in such a manner as to resemble mechanical toys. They begin their southward migration the latter part of August, and are nearly all gone by September 10. Those migrating from further north are seen on the river for a few days the first week of September." — N. G. B.

49. **Gallinago gallinago** (*Linn.*). — Three specimens, all males, Gichiga, May 23 and 25, and June 4.

"Snipe. Russian, *Koó-lĕk*. A regular and not uncommon summer resident. They first appeared on the low tundra along the seacoast, May 20, when I saw three. Next day I saw but one there. On the night of the 23d of May, while returning across this marsh from goose shooting at 11 o'clock, I was attracted by a bird note far off on the tundra, which sounded like the noise made by a rusty pump-handle in motion, or a piece of machinery in motion that needed oil,— a regular recurrent creak, *oo-ee*. Proceeding in that direction, I soon flushed two of these snipe, which flew away uttering their peculiar *tsweep*. A minute later I heard above and in front of me a rapid, sibilant, drum-like vibration, and for the next few minutes, while I stood with gun cocked, I heard this sound at intervals of a few seconds from every quarter of the compass, as if the bird was circling rapidly around me, although I could see no bird. It was the most distinct yet elusive sound that I ever heard, and as I could see nothing, although the nearly full moon and bright northern twilight made distant objects in the landscape plain, I began to doubt whether I heard anything at all. Suddenly it ceased and I heard a splash in a little pool, thirty yards distant. Upon approaching it I again flushed two birds, and got one of them, No. 646, as it flew over the pool. They also have a short, low whistle. Later I saw and heard one near my station during the day. A pair nested in the grassy marsh on the higher tundra in June, but I was unable to locate the nest. Saw none after August 15." — N. G. B.

Marcova: "Only three seen, but many are heard passing over on migrations. One was taken in May, 1899." — N. P. S.

50. **Limicola sibirica** *Dresser*. — Eleven specimens: Gichiga, 10, taken July 19 and 31, August 17, 23, and 27, and September 2 and 7; Marcova, 1, June.

"These sandpipers have already [August 17] collected in large flocks, of twenty-five to two hundred birds, and fly up and down the beach. They feed on the maggots found in the decaying salmon, which have been left on the beach by the tide, and especially about the fish-drying racks. With one load of dust-shot I killed twelve. They were gorged with maggots, which would crawl out of their mouths, while the digested ones oozed from the rectum. They were very fat, and the Russians said they were good eating, but I did not try them." — N. G. B.

51. **Pelidna alpina** (*Linn.*). — Forty-eight specimens, of which 42 are from Gichiga and 2 from Marcova; 43 are adults in breeding dress, 1 an adult in fall plumage, and 4 are young of the year. The spring specimens were taken May 25 to June 1, and two on June 24; the fall specimens were collected August 23 to September 9.

In 28 spring males, the bill (culmen) measures 30–35 mm., averaging 32.7; in 14 spring females, the same measurement is 34–40 mm., averaging 37.2.

The two specimens from Marcova, a pair, are rather above the average in size, and are more brightly colored, and may be referable to *Pelidna alpina sakhalina*, agreeing very well with American specimens in summer dress.

"Red-backed Sandpiper. The most abundant of the shore birds at Gichiga. The first appeared May 22, flying high overhead, and they became common by the 26th, feeding in flocks on the marsh and along the river, in company with the small sandpiper like No. 1065 [*Actodromas ruficollis*]. By June 1 they had mostly paired and scattered out on the tundra, preparatory to nesting and moved further on. Their breeding note is so distinctive that once heard it is never forgotten. It is an exact reproduction of the little marsh-frog's note that one hears in our North Central States early in March when the ponds are thawing out. They have two variations to this trill—one given low, and in rhythmical beats, and the other shriller and prolonged. The latter is exactly imitated by removing the ends of a small tin can and replacing one end with a piece of parchment, through the center of which is run a short piece of catgut knotted on the inside. The free end of the gut is then looped over the end of a small, round, rosined stick, and the can made to rotate by holding the distal end of the stick and swinging in a small circle. Such a toy was on the market a few years ago. Eggs are deposited by the latter part of June, and the young are seen by the middle of July. The nest is simply a slight depression in the grass near a tundra pool, lined with a little grass and a few leaves. The eggs are four in number.

"By the middle of August, they have again collected in flocks—some of them very large—on the marsh and along the river. Near my cabin was a fish-drying rack, and the ground under this was covered with maggots that had fallen from the fish. The Red-backs and the smaller *Tringa* (No. 1065 [=*Actodromas ruficollis*]) collected here in one large mixed flock during the latter half of August and gorged themselves on the maggots. Later, they move out on the great mud-flat at the head of the Gulf, and collect into a few immense close flocks that can be seen for a distance of three or four miles, as they flash in the sunlight when on wing. They are mostly gone by September 15." — N. G. B.

Marcova: "Sometimes abundant; breeds." — N. P. S.

52. **Ancylochilus subarquatus** (*Güldenst.*). — One specimen, male, Gichiga, June 2.

"This specimen was feeding with a large flock of Red-backed Sandpipers on the maggots under the fish-drying racks along the river when I shot it. It was the only one seen at Gichiga." — N. G. B.

53. **Actodromas damacensis** (*Horsf.*). — Seven specimens, Gichiga, June 4 and 7, and August 3, 4, and 20. Not distinguished by Mr. Buxton from *A. ruficollis*, the notes on which apply in part to *A. damacensis.*

54. **Actodromas ruficollis** (*Pallas*). — Thirty-eight specimens, all from Gichiga, of which 29 are in breeding dress (May 28 to July 16), the others being in fall plumage (August 23).

"Abundant spring and fall migrant, and some breed at Kooshka, but the majority move further inland during the breeding season. First birds arrived May 28, and were common on the 30th in large flocks and in company with the Red-backed. By June 5 they have paired or passed on, and are not common again until the second week of July. They have mostly gone by September 11. In habits similar to *Pelidna alpina*. See notes on that species." — N. G. B.

55. **Pavoncella pugnax** (*Linn.*). — One specimen, a bird of the year, Gichiga, August 30.

"Taken along the bank of the river. The only one that I saw while at Gichiga. Undoubtedly rare and does not breed." — N. G. B.

Marcova: "Not common; breeds." — N. P. S.

56. **Rhyacophilus glareola** (*Linn.*). — Sixteen specimens, taken at Gichiga at intervals from May to September, and illustrating the plumages of both adult and young, as follows: 4 males, May 24, 28, and 31; 3 males and 1 female, June 4, 7, 24, and 27; 3 males and 1 female, adults in autumn plumage, August 1 and 4; 2 adult males and 2 half-fledged young, July 12, 16, and 26.

"Not uncommon. Arrive last week of May, pair immediately, and proceed to nesting. They do not arrive or collect in flocks in the spring as do the sandpipers. They nest on the higher tundra near the little tundra pools. At this season the males mount high in the air and circle and soar over the locality of the nest, and sing almost continuously for an hour or more before descending to the ground again. The song is a clear mellow whistle, which could hardly be distinguished from that of the Tufted Titmouse. It always begins with a half note and rapidly repeats *peto*, four to six times. They are gone from the tundra by the latter part of August and have moved out to the mud-flats along the head of the bay, where they remain until the middle of September." — N. G. B.

57. **Glottis nebularius** (*Gunner.*). — Three specimens: 1 adult male, Gichiga, July 7; 2 young males, August 29.

"Saw two pairs of these birds around swamps in the larch woods at Christova, where they were evidently breeding. They would circle about over me rapidly, uttering a whistling *sweet, sweet*, for a time, and then alight on the topmost branch of a dead tree. No. 875 is from one of these pairs. Also heard several more that I did not see. During the last week of August they were common about the chain of tundra pools near the mouth of the river, but soon disappeared." — N. G. B.

58. **Pseudototanus guttifer** (*Nordm.*). — A single specimen of this rare species was taken at Gichiga, August 2.

"Saw three of these birds together along the gravelly border of the river, of which this is one. An almost continual patrol of the river banks rewarded me with a number of species of shore birds; but none of them, with the exception of the sandpipers, were ever common, and the collection of the large shore birds represents nearly all that I ever saw and all that I was able to kill." — N. G. B.

59. **Terekia cinerea** (*Güldenst.*). — Seven specimens: 4 from Gichiga, July 28 and August 3 and 4; 3 from Marcova, May 18.

"No. 958 was taken on a gravel bar in the river. It was alone.

No. 991 is one of several I saw along the river bank. Nos. 1002 and 1003 were killed out of a bunch of five that were running along the gravelly bank of the river. Saw no others." — N. G. B.

60. **Tringoides hypoleucos** (*Linn.*). — Four specimens: 3 from Gichiga, June 2 and 7, and August 3; and 1 from Marcova, June 7. One of the Gichiga specimens is a two-thirds-grown young bird.

"I saw a few single birds of this species during the first week in June, along the river bank and sloughs, and on June 15 I saw a pair along a little stream which flows into the sea near Matuga, which I am certain were nesting. When running on the ground they wag their tails like the Spotted Sandpiper." — N. G. B.

Rare at Markova (Sokolnikoff).

61. **Heteractitis brevipes** (*Vieill.*). — Ten specimens: 4 adult and 2 young from Gichiga, May 1, 4, 7, and 24 (adult), and August 6 and 20 (young); and 4 adults from Marcova, May 28 and 30.

"Not common. Observed only in spring. A few single birds seen along river banks and sloughs leading from the river at high tide to the sea. Does not breed at Gichiga." — N. G. B.

62. **Totanus ater** (*Sander*). — Six specimens: 2 males and 3 females, all in fall plumage, Gichiga, August 30; and 1 adult in breeding plumage, from Marcova, May.

"During the last week of August and the first of September I saw three or four small flocks of these birds standing on the banks of the tundra pools near the river's mouth." — N. G. B.

Marcova: "The only one observed." — N. P. S.

63. **Limosa lapponica baueri** (*Naum.*). — Five specimens: 3 from Gichiga, June 5; and 2 from Marcova (no date).

"Tolerably common spring and fall migrant. Arrives the latter part of May and remains until the middle of June, feeding on marshes along the water front. Returns the latter part of August and collects in large flocks far out on the mud-flats, exposed at low tide, and remains until the middle of September." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

64. **Numenius phæopus variegatus** (*Scopoli*). — Two specimens: a young bird from Gichiga, September 8; and an adult from Marcova.

"This bird (No. 126) was feeding on ground-berries on the low tundra when I shot it. It was alone. Extremely fat and evidently hatched near there. On several occasions—May 29, June 22, and 23, 1901—I saw and heard Long-billed Curlews, which were possibly this species." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

65. **Arenaria interpres** (*Linn.*). — Six specimens, of which 3 are from Gichiga, May 29 and 31; 1 from Lake Kanka, June 2; and 2 from Novo Marinsk, June 4.

"Turnstone. Rather rare spring migrant. During the latter part of May, I saw a few single birds along the gravelly bank of the Gichiga River." — N. G. B.

66. **Squatarola squatarola** (*Linn.*). — Four specimens, Gichiga, as follows: a male in breeding dress, July 22; two males and a female in fall plumage, September 23 and October 5.

"Spring and fall migrant; not common. September 23, 1900, I saw five feeding on the marsh near the sea; and October 5, 1900, I saw one lone bird along the river. On July 22, 1901, I saw four along the sea beach south of the mouth of the Ovecho River; and on May 24, 1901, saw a few flying northward." — N. G. B.

67. **Charadrius dominicus fulvus** (*Gmelin*). — Two specimens, young males, Gichiga, August 29 and September 10.

"Not common; spring and fall migrant. I saw and heard a few flying northward on May 24 and 25, 1901, but none stopped. During the latter part of August and first of September, I saw a few single birds feeding on black ground-berries, which grow so abundantly on the lower tundra. September 23, 1901, I saw three single birds flying southward." — N. G. B.

68. **Ægialitis mongola** (*Pallas*). — Three specimens, two males and a female, June 2 and 3.

"No. 757 was feeding in company with five Red-backed Sandpipers along the river bank near my station when killed, June 2, 1901. On the following day, two more single birds, in company with the sandpipers, were taken further down the river. No more were seen." — N. G. B.

69. **Ægialitis hiaticula** (*Linn.*). — Eleven specimens, of which 9 are from Gichiga and 2 from Marcova, collected as follows: Gichiga, May 23–June 1, and August 31; Marcova, May 31 and June 7. All are in breeding dress, except the single specimen taken in August.

"Rather common spring and fall migrant. More common in spring than in fall. First appears along the marshy beach at the head of the Gulf, May 20, while the sea is still filled with ice. A week or ten days later a few are seen feeding with the sandpipers along the river and on the higher marsh, but they soon pass on and are not seen again until the latter part of August, when some return for a few days and then leave for the south. No. 1060 is a young specimen taken at Gichiga, although I do not think that it was hatched there." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

70. **Urogallus parvirostris** (*Bonap.*). — One specimen, an old male in fine plumage, Marcova (Buxton), March 1.

"Black Grouse. Russian local name, *Tĕt-erev.* No. 496 in collection. One of two specimens taken at Yeropole about March 1, 1901, and brought to Marcova and given to Mr. Sokolnikoff, who says that they are common at that place, and also on the rivers Main and Pengina. He says that they feed in winter exclusively on willow buds, and are easily approached while feeding." — N. G. B.

71. **Lagopus lagopus** (*Linn.*). — Ten specimens, of which 7 are in the pure white plumage of winter and 3 in the dark brown plumage of summer; one is without locality or date; 8 are from Gichiga, collected as follows: September 5 (3 in summer dress), February 1 and 2 (4 in full winter dress), and May 3 (1 beginning to show a few feathers of the summer dress). Another winter specimen is from Werchojinsk, northeastern Siberia, March 10 (W. Jochelson).

"Willow Ptarmigan. Russian name, *Căr-o-pat-ka.* An abundant resident in favored localities all over northeastern Siberia. Spends the winter along the river bottoms, feeding on the buds of the willow and white birch trees. There were very few near my station at Kooshka, on account of lack of suitable food; but thirty miles up the Gichiga River they were common. They were especially abundant at Pengina, and during the early morning and evening I saw hundreds of them perched in the trees along the river feeding. They were very shy at that time and could not be approached. During the middle of the day they remain quietly concealed in the thick patches of undergrowth. They are caught by the inhabitants by deadfalls and snares. In May, when the snow begins to leave the rivers, they repair to the tundra, where they feed on the grass and weed seeds, and later nest. The natives affirm that they become 'snow blind' during May and may be approached and killed. About the first of May they begin to mate and during the long twilight hours that follow the setting of the sun, one can hear the 'crowing' or 'drumming' of the males far off on the tundra. I can describe this 'crowing' only by comparing it to the noise made by drawing a stick rapidly across five or six pickets on a fence, and then more slowly over four or five more. This is repeated at intervals of several minutes. They nest on the high tundra. Saw full-fledged young on August 1." — N. G. B.

Marcova: "Abundant; resident." — N. P. S.

72. **Lagopus rupestris** (*Gmelin*). — One specimen, from Marcova, in winter plumage, with feathers of the summer plumage beginning to appear.

"Rock Ptarmigan. Mr. Sokolnikoff, at Marcova, said that he had seen ptarmigan from the rivers Main and Yeropole which had a black stripe through the eye, which I take to be *L. rupestris*, or some undescribed form of it." — N. G. B.

73. **Astur palumbarius** (*Linn.*). — Two specimens: Gichiga, adult female, April 16; and Marcova, an immature female.

"Bought from a Cossack, who said it was the first that he had ever seen. I saw none." — N. G. B.

Marcova: "Rare; breeds; more common in the fall." — N. P. S.

74. **Astur candidissimus** *Dybowski.* — One specimen, adult, Marcova, August.

75. **Archibuteo lagopus** (*Gmelin*). — Two specimens, Marcova.

"This pair was taken together. Not common; breeds; leaves latter part of August." — N. P. S.

76. **Aquila chrysaëtos** (*Linn.*). — Four specimens, all from Marcova; adult female, collected by Mr. Buxton, February 15, 2 collected by Mr. Sokolnikoff, and 1 by Mr. Axelrod.

"Common resident, nesting in cliffs along the smaller rivers, especially the Orlofki." — N. P. S.

77. **Thalassoaëtus pelagicus** (*Pallas*). — One specimen, immature male, Gichiga, October 10.

"Russian name, *O-rél.* On June 18, 1901, I saw a very dark-colored eagle, with white head and tail and white patches on wings, sitting on a gravel bar at the mouth of the Gichiga River. July 4, I saw another on a bar in the river; and July 10, I saw a pair of them at Christova, thirty-five miles up the river. The Russians say there are two species at Gichiga, and that this is the commonest and shyest." — N. G. B.

78. **Haliæetus albicillus** (*Linn.*). — Three specimens: Gichiga, immature female, May 7; Marcova, 2, immature. The Marcova specimens were taken in April and on August 20.

"Sea Eagle. Russian name, *O-ryel.* I saw but four of these eagles at Gichiga, October 10, 1900; April 17 and 23, 1901; and May 7, 1901. In March, 1901, I saw a very large eagle's nest in a cottonwood tree on the Pahrane River, which flows into Penginski Gulf, that probably belonged to this species." — N. G. B.

Marcova: "Rare; breeds; not resident." — N. P. S.

79. **Falco rusticolus** *Linn.* — One specimen, Gichiga, adult male, March 15.

"Rare. The only specimen observed." — N. G. B.

80. **Falco peregrinus** *Gmelin.* — One specimen, Gichiga, adult female, September 19.

"Duck Hawk. Russian local name, *Yah'-strip.* Quite common during the summer along the seacoast, where it breeds in crevices in the rocks. I found one pair nesting near Matuga, June 13, 1901, although I could not reach the nest, as it was placed in a hole in the soil at the top of a cliff 150 feet high. After the nesting season they spend their time along the rivers and inland in pursuit of young ducks, phalaropes, and sandpipers. I saw them first in 1901 on June 3, and last on October 18." — N. G. B.

81. **Falco regulus** *Pallas.* — Two specimens, immature male and female, September 7 and 8.

"Not common. Observed only in the fall about the chain of tundra pools along the water front, where I saw several at different times in pursuit of longspurs and wagtails." — N. G. B.

82. **Pandion haliaëtus** (*Linn.*). — One specimen, Gichiga, adult male, July 8.

"Osprey. Russian local name, *Scō-pah'.* Quite common on the upper parts of the Gichiga and Ovecho Rivers, where the timber is large enough to afford it nesting sites. Arrives middle of May and remains until the first week in October, when the ice begins to form." — N. G. B.

Marcova: "Rare; breeds." — N. P. S.

83. **Asio accipitrinus** (*Pallas*). — Three specimens, two males and a female, Gichiga, September 20 and 29, and October 12.

"Short-eared Owl. Not common. Probably breeds. Saw only three, and all in the fall. This species appears at Point Barrow, Alaska,—some years in large numbers, and breeds, and in other years it is almost entirely absent. The migration of lemming may have something to do with its movements there, as it does with that of *Nyctea nyctea*." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

84. **Scotiaptex cinerea lapponicum** (*Retzius*). — One specimen, Marcova, male, February 10 (Buxton).

85. **Nyctea nyctea** (*Linn.*). — Two specimens, both adult females, Gichiga, February 11 and April 4.

"Snowy Owl. Russian local name, *Fee'-lĕn*. Very common at Gichiga some winters and entirely absent during others. Arrives in November and departs in April. The two specimens in the collection were all that I heard of during the winter of 1900–1901. Specimen No. 400 was found frozen on the tundra and had evidently died of starvation." — N. G. B.

Marcova: "Irregular winter visitant." — N. P. S.

86. **Surnia ulula doliata** (*Pallas*). — Five specimens: Marcova, male and female, March 1; three specimens, September.

"Hawk Owl. Rare at Gichiga. On February 9, 1901, I saw one flying over the tundra near my station, and on February 19 a Cossack brought me one which was so badly mutilated that I could not make a skin of it. All in the collection are from Marcova, where they are common." — N. G. B.

Marcova: "Common; resident; breeds." — N. P. S.

87. **Cuculus canorus telephonus** (*Heine*). — Three specimens: Lake Kanka, male, June 1; Gichiga, male, June 7; Marcova, June 5.

"Russian name, *Coo-coosh'-ky*. Not common at Gichiga, and confined to the thick growth of willows and alders along the streams back from the seacoast. Probably more abundant inland. Besides the one in the collection from Gichiga, I heard and saw but three others, all during the second week of July on the upper Gichiga. The note is a long-drawn *cuck-coo*, accented on the first and prolonged on the second syllable.

"In the vicinity of Vladivostok and at Lake Kanka they are very common." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

88. **Jynx torquilla** *Linn.* — One specimen, male, Lake Kanka, May 31.

"Caught while excavating a hole in a fish-drying rack. Not common, as there is very little suitable timber here for nesting sites." — N. G. B.

89. **Dryobates purus** *Stejneger.* — One specimen, a female, collected April 5.

"Russian name, *Dyah'-tĕl.* This specimen was brought to me by an old man who said he got it in the pine woods near Niakinsk, about sixty miles southwest of Gichiga. While at Christova, a place thirty miles up the Gichiga River, in July, I saw numerous old woodpeckers' holes in the dead larch and willow trees there, but neither saw nor heard the birds. A man living there said that he had heard them, but never saw any." — N. G. B.

90. **Dryobates minor immaculatus** (*Stejneger*). — Three specimens: 2 males and a female, Marcova, without date.

These specimens agree with Stejneger's *immaculatus* in having pure white under tail-coverts and the outer rectrices pure white, without any trace of dusky bars in the males, and with a small dusky spot on the inner vane in the female.

Given as "rare" at Marcova by Sokolnikoff.

91. **Picoides tridactylus crissoleucus** (*Bonap.*). — Five specimens: 2 males and 3 females, taken as follows: Marcova, female, March 1, (Buxton); Marcova, 2 males and 2 females, May and June (Sokolnikoff).

Given by Buxton, on the authority of Sokolnikoff, as "common and breeds" at Marcova.

92. **Chætura caudacuta** (*Latham*). — Not represented by specimens, but without doubt the species referred to by Mr. Buxton in the following notes:

"On July 24 and 25, 1901, I saw half a dozen pairs of black or dark colored Swifts, with white rumps and light colored triangular patch on throat, nesting in the crevices of the high sea wall south of the mouth of the Ovecho River. I killed two, but they fell into the sea, which came up to the base of the 200-foot high cliff, and I was unable to get them. I saw some about the cliffs at Chevitka on the opposite side of the Gulf. The Russians say that they are also abundant far up the Gichiga, where they breed [=assemble ?] in hollow trees in immense colonies." — N. G. B.

93. **Alauda intermedia** *Swinhoe.* — One specimen, male, Lake Kanka, June 1.

"Very common. I saw it all along the way from Nikolsk to the lake. This was the first time I ever had an opportunity to hear a Skylark sing. This one was shot while singing on the wing."—N. G. B.

94. **Alauda buxtoni,** sp. nov.

Type, No. 77175, ♂ad., Gichiga, northeastern Siberia, May 3, 1901; N. G. Buxton.

Similar in size to *Alauda blakistoni* Stejn., but more heavily streaked on the breast and flanks, and with the dark centers of all the feathers of the dorsal plumage, including those of the head and rump as well as the interscapular region, much broader, giving a much darker general effect; in color thus resembling *A. intermedia* Swinh. of the Amoor region, but much larger. Wing (type), 120 mm.; tail, 84; three males, wing, 114–120 (118.7); tail, 76–83 (78.7): two females, wing 108 (107–109); tail, 73 (72–74). The *females* are slightly larger than Vladivostok *males* of *A. intermedia*, while the males have the wing fully a half-inch longer.

Five specimens, three females and two males, Gichiga, April 30, May 3, and 5, and September 7.

The size alone would prevent the reference of the Gichiga specimens to either *A. arvensis* or *A. intermedia*, while both size and color prohibit their reference to *A. japonica;* despite the agreement in size, the difference in color renders them obviously different from *A. blakistoni*, with topotypes of which I am able to compare them. As no earlier name is apparently available for the Gichiga form, I take pleasure in naming it for the collector, Mr. N. G. Buxton, whose careful work in the Gichiga region has yielded such important results.

"Russian name, *Jav-or-on-ok'*. The first lark was observed at Kooshka, May 1. By the 3d they were common, but soon passed on to the high, rolling tundra further inland, where they nest. By the middle of August they begin their southward migration, and were again seen in small loose flocks and singly on the tundra for a short time. The young and females had all gone by the third week in September." — N. G. B.

95. **Pica camtschatica** *Stejneger.* — Fifteen specimens, 9 males

and 6 females, all from Gichiga, taken April 19, 24, and 29, June 21, August 29, September 10, October 9, 14, and 31, and November 5.

This form of the common Magpie differs so strongly from the European and North American forms, through its larger size, shorter and much thicker bill, absence of blackish apically on the primaries, and the very broad, pure white rump band, that it seems best to treat it as a full species.

"Magpie. Russian name, *Sō-rō'-kah.* Abundant resident. During the winter they stay around the isolated houses and settlements, feeding on refuse and the bits of fish that the dogs leave. At that time they become very tame, and I have seen them picking at one end of a dried salmon which a dog was eating, and hopping just beyond the reach of the harnessed dog when it made for the bird. About the middle of May they separate and go to the foothills and along the streams, where they begin nesting. They are the earliest nesters, and I found eggs by the last week of May. Their loose, bulky nests of sticks and twigs are placed in the tops of the low willows, and contain five or six eggs. In the fall they make daily excursions to the settlements and return to their nesting grounds at night. At Kooshka they became so persistent in their attempts to carry off my minimum thermometer, hanging on the side of my cabin, that I had to encase it until I had exterminated all that visited me." — N. G. B.

Marcova: "Common resident." — N. P. S.

96. **Perisoreus infaustus** (*Linn.*). — One specimen, Werchojinsk, northeastern Siberia, March 26, W. Jochelson.

Marcova: "Rare summer visitant." — N. P. S.

97. **Corvus corax behringianus** *Dybowski.* — Six specimens, 4 males and 2 females, Gichiga, May 3, September 16, October 14, November 17, and December 14.

These specimens are provisionally referred to this form, with which they agree in size and wing formula, the first primary being decidedly shorter than the seventh in five of the specimens, and just equal to it in the other; the fourth the longest, and the third 25–30 mm. shorter than the fifth; the length of the wing ranges from 440–450 mm. It is thus not an insular form, as regarded by Stejneger.

"Raven. Russian name, *Vō-ron'.* An abundant resident. One of the most interesting and conspicuous birds in northeastern Siberia. During the winter many of them congregate about the Russian and native settlements, where they find garbage and dead dogs for food.

When traveling in winter time one also encounters them on the barren tundra far from villages. At that time they will come up behind the sledge and sail slowly over the whole length of the dog teams, eying the outfit critically, alight on the snow off to one side of the trail, and then repeat the performance after the sledges have passed. The dogs prick up their ears and race madly over the snow so long as the raven continues in sight. For days at a time this is the only diversion that the traveler has from his monotonous journey. They are a sacred bird to the Koraks, who hang reindeer heads and pieces of meat on poles about their camps for them.

"At Kooshka, about the first of April, they begin to fly down the river every evening in large numbers to the sea, where they roost, and return up the river the next morning. They come straggling down after their day's foraging like a lot of children just out from school. Some play on the way, chasing each other and circling about anything that attracts their attention; some fly rapidly along, alone and in groups of four or five; while others amuse themselves by uttering all their notes and calls. Have often heard one far up the river, long before it came in view, running over these notes, and it continued until it passed and disappeared over Maiak Point, two miles distant. They have seven distinct notes.

"When sailing along, looking for food, they have a curious way of closing one wing and dropping several feet on that side, and then extending it and closing the other, repeating this several times, which makes them appear to revolve in the air.

"By the end of May they have all repaired to the cliffs along the sea where they nest. After the breeding season is completed they spend their days along the water and lower stretches of the river eating salmon, and at night go up the river to roost." — N. G. B.

98. **Corvus corone levaillantii** (*Lesson*). — One specimen, a bird of the year, just beginning to acquire the metallic plumage of the adult, Gichiga, August 1.

99. **Nucifraga caryocatactes macrorhynchos** (*Brehm*). — Three specimens, an autumn male from Gichiga, September 2; and a male and female from Marcova, April 27.

As these specimens do not agree with *N. kamchatkensis* Barrett-Hamilton, they are referred to *macrorhynchos*.

"On the evening of September 2, 1900, while standing outside my cabin, this bird suddenly came flying across the tundra and pitched into a little garden near by, where I shot it. It was the only one I observed at Gichiga, and the people there were unacquainted with it. Mr. Sokolnikoff says that it is quite common at Marcova, where it arrives in March and breeds." — N. G. B.

100. **Acanthis linaria** (*Linn.*). — Twelve specimens, 6 males and 6 females, all from Gichiga, except one from Marcova, April 26. The Gichiga specimens were taken April 16 and 24, May 28, August 20, and September 25. One of the September specimens is in fall plumage (apparently a bird of the year), and the other is still mainly in the first or juvenal plumage, showing that it must have been hatched late in August. The single August specimen is in moult from the juvenal into the second or fall plumage.

The following notes by Mr. Buxton probably relate mainly to this form.

"Redpoll. One of the earliest birds to arrive and the latest to depart, and I am not certain that they are altogether absent at any time of the year. Abundant. On February 25, 1901, I saw one at the Pahrane River; March 1, a small flock at the Ooskon Pass near Pengina; April 1, a number at Leftchick, twenty-five miles up the Gichiga River; and on April 16 they were common at Gichiga, feeding on seeds that grow on the sod roofs of the houses. They first appeared at Kooshka on April 23, and were common from that time on, in the little patches of willows and alders, in which they nested, and which grow in the protected places about the lakes on the higher tundra and along the streams. Late in the summer they collect in small flocks and stay about the patches of shrubs, and later assemble in larger flocks. September 27, 1901, I saw a flock of more than 200 along the Ovecho River, but saw no more that fall." — N. G. B.

101. **Acanthis linaria holbœllii** (*Brehm*). — Three specimens: Gichiga, male, April 16; Marcova, male and female, May 22 and 25.

102. **Acanthis hornemannii exilipes** (*Coues*). — Nine specimens, as follows: Gichiga, 6 males, April 16 and 24 and May 28; and 2 females, in fall plumage, September 25; Marcova, 1 male, May 16.

Marcova: "Common; breeds." — N. P. S.

103. **Leucosticte arctoa** (*Pallas*). — One specimen, a female in worn plumage, Gichiga, July 25. The greater coverts are narrowly edged with crimson; flanks, lower back, and rump with the feathers edged with grayish and pale crimson. The whitish edging of the

quills is nearly worn away, leaving the quills dusky brown. It thus does not agree well with the descriptions of *arctoa*, to which it is doubtfully referred. Wing, 100 mm., or considerably shorter than the length given for *arctoa.*

"Saw three of these in the rocks along the coast of the Taiganose Peninsula, south of the mouth of the Ovecho River, on July 25, 1901, of which this is one, and one opposite Matuga Island on June 12, 1901. Not present at Kooshka." — N. G. B.

104. **Fringilla montifringilla** *Linn.* — One specimen, a young bird in juvenal plumage, with the quills not fully grown, Gichiga, July 11.

"Not rare. Found one pair breeding on the tundra, July 8, 1901, and one young bird, July 11, 1901. Arrive first of June and are gone by second week in September. Nest of grass lined with feathers, placed under the edge of a bunch of grass." — N. G. B.

105. **Carpodacus erythrinus** (*Pallas*). — One specimen, adult male, collected at Marcova, Anadyr Province, by N. P. Sokolnikoff, in June, 1899. Given by Buxton, on Sokolnikoff's authority, as "Common; breeds."

106. **Pinicola enucleator** (*Linn.*). — Eight specimens: Gichiga, 2 females, July 21; Marcova, 2 adult males, 4 adult females, April 17–26.

"On July 21, 1901, I was crawling through the thick growth of dwarfed pines and alders which covers the old coast line back from the present head of the Gichiginski Gulf, looking for a thrush, when the male of this pair jumped up on a shrub twenty feet from me, which I killed. I then heard the female a few yards further on, uttering a trilling whistle like that made by a boy by whistling on his teeth, and soon got her. The male had two caterpillars in his throat. Breasts of both were bare, indicating that they were nesting. Rare at Gichiga, as people were unacquainted with them and they were the only ones I saw."—N. G. B.

107. **Uragus sibiricus** (*Pallas*). — One specimen, an adult male, Lake Kanka, June 1.

108. **Emberiza rustica** *Pallas.* — Eight specimens: Gichiga, an adult male (July 7) and a nestling (July 9); Marcova, 6 adult males, May 16, 17, and 22.

"Rare. I saw three in larch woods at Christova, July 7, where they were undoubtedly breeding. The young bird, taken July 9, was killed in willows along the Gichiga River, twenty-five miles above its mouth." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

109. **Emberiza pusilla** *Pallas.* — Two specimens, males, Marcova, May 16 and 17.

"Common; breeds." — N. P. S.

110. **Emberiza fucata** *Pallas.* — One specimen, a breeding female, Gichiga, July 12.

"Rare. Killed on the tundra, near my station. The breast was bare from incubation." — N. G. B.

111. **Emberiza** sp., near **citrinella.** — One specimen, "male," in fall plumage, Gichiga, August 20.

112. **Emberiza aureola** *Pallas.* — Three specimens, all males: Gichiga, July 8, a male in immature plumage; Marcova, two adult males, May 22 and 24.

Marcova: "Common; breeds." — N. P. S.

113. **Passerina nivalis** (*Linn.*). — Forty-six specimens, of which 36 are from Gichiga, 9 from Marcova (April 15–19), and 1 from Indian Point (Bogoras, June 1). Of the Gichiga specimens, 28 were taken in October (October 11–24) and 8 in April (April 10–29).

"A few Snowflakes arrived at Kooshka on October 3, 1900, but they did not become common until the 6th, when a heavy snowstorm from the northeast brought them in large numbers. These soon moved on and were replaced by new arrivals until the last week of October, when they reached their maximum of abundance. About the first of November they began to diminish in numbers, and during November, December, January, February, and March only two or three remained about the settlement. In April they were again common, and the last one left on May 6. When they were common during the early winter and spring, they collected in a flock and visited the patches of ground about the settlement swept bare of snow by the wind, and the old sod-covered house roofs, in search of seeds. Three remained around my cabin, and I fed them with meal nearly every day. One of them began to sing on February 21, and continued to sing on fair days until they left." — N. G. B.

114. **Calcarius lapponicus** (*Linn.*). — Thirteen specimens, in breeding plumage,—8 males and 5 females,—all taken at Gichiga, May 25–29, and June 4 and 7, except one from Marcova, taken June 22.

The series does not differ appreciably from specimens from Greenland and the eastern United States, in either size or coloration.

"Longspur. Rather abundant summer resident. Begins to arrive the first of the last week in May and becomes common by the first of June. Nests on the tundra, placing the nest of moss and grass, lined with feathers, under the edge of a grass hummock. The eggs vary in number from four to six, generally five or six. The height of the breeding season is reached about June 1. They begin to leave the latter part of August, and are all gone by the middle of September. They are very pleasing singers, and are often heard as late as 11 o'clock at night, and as early as 2 A.M." — N. G. B.

115. **Hirundo rustica tytleri** (*Jerdon*). — Four specimens, two males and two females, Gichiga, June 6, July 2, and 31.

In all of these specimens the pectoral color is incomplete, and the color of the underparts is very deep chestnut, much darker than in the darkest males of *H. erythrogastra.*

"Russian name, *Las-toch'-kah.* A few pairs nest at Gichiga and Kooshka. Arrive during first week of June and depart the middle of August. The nests are built under the eaves of log cabins and on rafters of abandoned cabins. Three pairs nested at Kooshka, of which I got two pairs in spite of the protests of the residents. They were abundant at Okhotsk and Ola.

"At Lake Kanka they were abundant. The Korean fishermen's quarters there was a low mud-plastered building, 20 by 30 feet, with small windows and one low door. Along each side of it were one hundred bunks, where the men lounged and slept. Over these bunks, on the stringers that supported the rafters, were six swallows' nests, and the birds flew in and out of the windows and door, zigzagging amongst the men as unconcerned as though no one was present." — N. G. B.

116. **Riparia riparia** (*Linn.*). — Four specimens, two of which are from Gichiga (June 17), and two from Marcova (June 6 and 8).

"Bank Swallow. Russian name, *Las-toch'-kah.* Common summer resident. Arrives the first of June and departs by the third week of August. Nests in the banks along the Gichiga and Ovecho Rivers and along the seacoast. There is said to be a very large colony just above the settlement of Gichiga. I saw one small one of three nests in the top of a high bank along the seacoast, and another four miles above Kooshka on the Gichiga River." — N. G. B.

117. **Muscicapa albicilla** *Pallas*. — One specimen, Gichiga, September 6, in the dress of the female, but sexed by the collector as a male. It is a bird of the year.

"Taken in a patch of shrubs along the river, September 6, 1900. Saw no others." — N. G. B.

118. **Anthus gustavi** *Swinhoe*. — One specimen, male, in rather worn plumage, Gichiga, July 25.

119. **Anthus cervinus** (*Pallas*). — Seven specimens, all males but one, Gichiga, June 5, 7, and 27, and July 12.

"Common. Arrives first of June and remains until the middle of September, although most have gone by the last of August. The nest is made of grass, and is placed under the edge of a bunch of grass on the edge of the tundra. Five or six eggs are deposited by the last of June. They are excellent songsters, singing while on wing. They prefer the dryer parts of the tundra, and collect in large loose flocks after the breeding season is over." — N. G. B.

120. **Anthus anadyrensis** sp. nov.

Type, No. 77357, ♂ ad., Gichiga, northeastern Siberia, October 6, 1900; N. G. Buxton.

General size, size of bill and length of hind claw as in *Anthus pratensis*, from which it differs in less olivaceous coloring above, with the dark centers of the feathers heavier, and continued over the rump and upper tail-coverts, which are strongly instead of obsoletely streaked; below washed with deep buff instead of yellowish buff, and the dark streaks rather heavier; white spot on the penultimate tail feather broader and less wedge-shaped. In fall plumage, the feathers of the upper surface, including the quills, are edged with buffy brown instead of olivaceous, and the lower parts are much less yellow. Wing, 77 mm.; tail, 63; exposed culmen, 10–11.

Three specimens, in fall plumage, 2 males and 1 female, Gichiga, August 20 and October 6 and 10.

As indicated above, this species differs from *A. pratensis* (compared with both spring and fall specimens from England) very decidedly in coloration, but not essentially in size or structure. It differs from *A. gustavi* (Bering Island and Gichiga specimens) in much smaller size, disproportionately much smaller bill, absence of whitish edgings on the interscapulars, and in the white areas of the outer tail feathers being clear white instead of dull buff or brownish-white. From the season when these specimens were taken, they were evidently migrants from further north, probably from Anadyr Province. It appears to be a well-marked geographical representative of *A. pratensis.*

121. **Parus borealis baicalensis** (*Swinhoe*). — One specimen, Marcova, June, in bad condition.

"According to Mr. Sokolnikoff, this is an abundant resident. I saw several and heard them sing at Marcova in March, 1901." — N. G. B.

122. **Motacilla ocularis** *Swinhoe.* — Seventeen specimens, of which 14 are from Gichiga, collected by Mr. Buxton, May 17 to October 2; 3 from Marcova, May 12 and 25, and 1 collected in June.

"Abundant. The first birds arrive the middle of May, but they do not become common before June 1. Before and after the nesting time they are seen in twos and threes about the houses and along the river banks and seacoast, but they never collect in flocks like the Yellow Wagtails, and are seldom seen far back on the tundra. They nest in the crevices in the banks of the streams and along the seacoast and on the ground in the grassy places along the streams. They are good songsters, singing especially while on wing. They begin to depart the latter part of August and are seldom seen after the middle of September." — N. G. B.

Marcova: "Abundant; breeds." — N. P. S.

123. **Budytes flavus leucostriatus** (*Homeyer*). — Nineteen specimens, collected as follows: Lake Kanka, adult male, June 7; Gichiga, 12 males and 4 females, June and July; Marcova, 3 males, May 24 and 25.

The series contains one in first plumage, taken July 16, a bird of the year in fall plumage, taken August 27, and two in moult, taken September 20 and October 2. The young bird in juvenal plumage was only a few days from the nest when taken, the quills being not fully grown. As I have met with no description of this plumage, which is strikingly different from the succeeding stages, it may be here described:

Above dark brown, darker on the head and interscapulars, which parts are strongly washed with blackish; postocular stripe, chin and whole throat, and a broad stripe below the ear-coverts, yellowish buff; ear-coverts blackish brown; broad superciliary stripes and malar stripes blackish, the latter joining a broad pectoral crescent of black; lower breast, flanks and under tail-coverts strong buff, slightly varied with blackish brown on the flanks and lower part of breast; belly pale yellow or yellowish white; quills as in the fall plumage. Compared with birds in the second or 'fall' plumage, the upper parts are dull rusty brown, irregularly washed with black, as above described, instead of being olive brown with a grayish tinge; the lower parts are much deeper buff and less yellow, while the broad black malar stripe and broad black crescent on the breast are only faintly indicated by a few irregular, faint, dusky markings in the fall plumage. The tone and pattern of the coloration are thus widely unlike what is seen in young birds in fall plumage.

"This is the most abundant land bird found at Gichiga. The first birds arrive during the last few days of May, and they are abundant by the end of the first week of June. For a short time after their arrival they are seen in loose flocks feeding about the fish-racks along the river, about the tundra pools and little streams, where they find maggots and other insect larvæ. By the middle of June they have scattered over the tundra and taken up the duties of nesting. The nests are placed under the edge of a tussock of grass, and are composed of grass loosely put together and lined with feathers and horse-hairs. The eggs, generally six, are clay color, thickly covered with fine, darker markings. As soon as the nesting is over, the latter part of July, they again collect in loose flocks on the tundra, when they are very tame. They begin to leave the latter part of August, and are all gone by the 15th of September." — N. G. B.

Marcova: "Common; breeds." — N. P. S.

124. **Calliope calliope** (*Pallas*). — One specimen, in fall plumage, apparently a female of the year, Gichiga, August 20.

"Rare. Besides the one in the collection, taken August 20, 1900, I saw a pair, May 24, 1901, and saw and heard two or three singing during June. All were observed in the pine and alder thickets along the crest of the old shore line back from the mouth of the river. Perhaps common in more suitable localities." — N. G. B.

125. **Lusciniola fuscata** (*Blyth*). — Three specimens, Gichiga, June 22 and 24, and September 20.

These specimens appear to be referable to *L. fuscata*, but may represent *L. homeyeri*, a point not determinable in the absence of authentic specimens of either form.

"Tolerably common in the little patches of shrubs on the lower tundra and along the streams. Breeds. Arrives first of June and departs by first of September. Saw several old nests placed in low shrubs which I took to be of this species." — N. G. B.

126. **Acanthopneuste borealis** (*Blasius*). — One specimen, Marcova, May 28, 1901.

127. **Turdus dubius** *Bechstein*. — One specimen, adult male, Gichiga, June 6, 1901.

"Rare, although probably a summer resident, breeding in suitable localities. Saw the first pair, June 1, 1901, in a thick growth of stone-pine and alder which covers the crest of the ancient coast line back from the river's mouth, and subsequently several more there during the summer. Residents were unacquainted with it and had no name for it. When startled they have a note similar to that of the Robin. Extremely shy and hard to approach. Excellent songsters, singing morning and evening from the top of a dead shrub. Saw no nests." — N. G. B.

59,57,96 F

Article XV.—NEW SPECIES OF FORMICA.

By William Morton Wheeler.

1. **Formica munda** sp. nov.

Worker. — Length, 5–7 mm.

Allied to *F. pergandei* Emery. Mandibles 8-toothed. Head, excluding mandibles, usually somewhat longer than broad, with straight posterior border and long cheeks converging anteriorly and slightly convex or flattened, but not concave as in *pergandei*. Clypeus carinate, with a rather deep median notch in its anterior border. Antennæ like those of *pergandei*. Thorax rather narrow and low, pro- and mesonotum not very convex, mesoëpinotal constriction shallow, epinotum long and low, its basal surface rather flat and somewhat longer than the very sloping declivity into which it passes through a rounded angle. Petiole thick and low, convex in front, flattened behind, with very obtuse upper border. Seen from behind the border is transverse, broadly rounded but passing rather abruptly into the straight sides which converge below Gaster small; legs slender.

Head and thorax subopaque, very finely shagreened. Mandibles, anterior portion of the head, and especially the frontal area and sides of the clypeus more shining. Mandibles sharply striatopunctate.

Pubescence grayish, very sparse, except on the gaster where, it is long and dense and conceals the shining surface except at the segmental incisures. Hairs on the body white, sparse, suberect and rather long, conspicuous on the upper and lower surfaces of the head, thorax, and gaster. On the gaster they are robust, obtuse, and very regularly distributed. The edge of the petiole is also fringed with hairs, and there is a row of oblique tapering hairs on the flexor surface of each tibia.

Head, thorax, and antennæ red; petiole and gaster black, the former with a reddish tinge. Mandibular teeth black. Lower pleuræ, and in many specimens also the vertex of the head, infuscated. Legs red, coxæ, femora, and tibiæ more or less blackened except at the articulations.

Female (deälated). — Length, 7.5–8 mm.

Resembling the worker except in the following characters: The hairs are of a yellowish cast, and on the gaster tapering and of the same thickness as on the head and thorax, although they are long and in certain lights conspicuous, especially toward the tip of the body. Pleuræ clouded with fuscous; posterior portion of head, posterior edge of pronotum and anteromedian and parapsidal blotches on mesonotum, fuscous. Metanotum and all except the anterior border of the scutellum, black. Petiole varying from dark red to blackish, of the same shape as in the worker except that in profile the superior border is much more acute in some specimens.

Described from seven females and numerous workers collected in the following localities: Cañon City, Breckenridge, and West Cliff, Colo., by the late P. J. Schmitt, O. S. B.; at Broadmoor and Roswell near Colorado Springs, Colo., by myself, and at Glorieta and Old Pecos Pueblo, New Mexico, by Professor T. D. A. Cockerell. This seems to be the form designated by Professor Emery as a variety of *F. pergandei* from Colorado (Zool. Jahrb. Abth. f. Syst. VII, 1893, p. 647). It is closely allied to this species but may be readily distinguished by the dense gray pubescence and obtuse white hairs on the gaster of the worker, and the less elongated head and more convex cheeks, especially in larger specimens. According to Emery's description of *pergandei*, it would differ also in having erect hairs on the lower surface of the head, but two cotypes of Emery's species in my collection—one received from Professor Emery and the other from Mr. Pergande — each have a few such hairs.

While collecting in the vicinity of Colorado Springs, during the summer of 1903, I found many colonies of *F. munda*. They were always in grassy places and most abundant in the irrigated plains about Broadmoor and in the pastures near the racing stables at Roswell. The species did not occur in the higher mountainous regions about Cheyenne Cañon and Manitou. The colonies were rather small, comprising only a few hundred workers, and made rather obscure mound-nests much like those of *F. schaufussi* and its varieties. I never found these colonies nesting under stones and in no case did they contain slaves, although a single colony of the allied *pergandei*, found in the very same locality (Broadmoor), contained workers of *F. subpolita*. It would seem, therefore, that although *F. munda* has a notched clypeus, it does not have the dulotic instincts of the allied *F. pergandei* and *sanguinea*.

2. **Formica dryas** sp. nov.

Worker. — Length, 5–7 mm.

With the habitus of *F. rufa*. Mandibles 8-toothed. Head, excluding mandibles, as broad as long, posterior border straight, sides rather flat, converging anteriorly. Clypeus sharply carinate, not produced in front, with nearly straight anterior border. Thorax rather robust, epinotal declivity much flattened, distinctly longer than the slightly convex basal surface. Petiole somewhat convex in front and very flat behind, with sharp superior border; seen from behind it is broad above in large workers and much produced in the middle, with straight sides rapidly converging below. Gaster and legs of the usual shape.

Head, thorax, petiole and appendages subopaque, finely but distinctly shagreened. Mandibles densely striatopunctate; clypeus and especially the frontal area smooth and shining. Gaster shining, very finely and transversely shagreened, with the appearance of "watered" silk.

Body clothed with short, erect or suberect, subobtuse, yellowish hairs, which are very conspicuous on the upper, lateral, and lower surfaces of the head, upper surface of thorax, and on the edge of the petiole; sparse and inconspicuous on the gaster, especially on its upper surface, and almost entirely absent on the antennal scapes. Eyes distinctly hairy. Pubescence yellowish, almost absent, except on the antennæ.

Head, thorax, petiole, and appendages red; gaster black or very dark brown, with red anal region. Small workers usually have darker legs and in some specimens the upper surface of the thorax is more or less infuscated.

Female (deälated). — Length, 7.5–8 mm.

Resembling the worker in coloration and sculpture, with the following differences. The red coloration of the head, thorax, petiole and appendages is somewhat duller, the posterior border of the pronotum, a large median mesonotal and two lateral parapsidal blotches, the greater portion of the scutellum and metanotum, dark brown. The gaster is smoother and more shining than in the worker. Hairs longer, tapering; somewhat flexuous on the head, thorax, and legs, conspicuous and erect on the antennal scapes and median portions of the eyes. Pubescence of head and thorax more distinct. Petiole very high with a sharp compressed edge.

Described from three females and numerous workers.

I have taken this species on three different occasions in the vicinity of Milwaukee, Wisconsin, and Rockford, Illinois. In a piece of woodland at Cudahy, south of Milwaukee, I found a flourishing colony, comprising three small mound-nests, strung along a well-worn path that had been made by the ants. This path was nearly an inch broad and in some places had been roofed over with dead grass and leaves for distances varying from several inches to two or three feet. Another colony was found at White Fish Bay, north of Milwaukee. It inhabited a single large mound-nest, possibly a natural hummock that had been enlarged by the ants, in shady woods. This colony, which seemed to be moribund or evanescent, comprised a few hundred workers and seven old deälated females. A third colony found near Rockford, Ill., was very similar but yielded no female specimens.

F. dryas is certainly very closely related to *F. rufa* and its various subspecies and varieties. This is especially true of the female *dryas* which has a highly glabrous gaster like that of the pure European type of *rufa*. The worker *dryas*, however, differs from the workers of all the American and European forms of *rufa* and resembles such species as *F. dakotensis*, *montigena*, *exsectoides*, and the next species to be described, in the peculiar shining "watered" silk surface of the gaster.

Var. **gymnomma** var. nov.

To this variety I would assign some workers that I have taken at Cold Spring Harbor, Long Island, N. Y., and in two localities near

Rockford, Ill. They differ from the typical form in having naked eyes and less hairy bodies. Some of the larger workers from the latter locality are almost as naked as *F. rufa* subsp. *integra.* The smallest workers from one of the Rockford colonies have the head and thorax very deeply infuscated.

3. **Formica nepticula** sp. nov.

Worker. — Length, 4–6 mm.

With the habitus of a small *F. rufa.* Mandibles 8-toothed. Palpi rather long. Head, excluding mandibles, a little longer than broad, cheeks slightly flattened, somewhat converging in front; posterior border straight, posterior angles rounded. Clypeus strongly carinate, its anterior border angularly produced in the middle. Antennæ of the *rufa* type. Thorax in profile with deep mesoëpinotal constriction; pro- and mesonotum rounded, hemispherical; epinotum evenly rounded, without any angle. Petiole large, as high as the epinotum, convex in front, more flattened behind, border rather sharp; seen from behind the upper border is transverse in the middle and obliquely truncated on either side, the lateral surfaces are straight and converge below. Gaster and legs as usual.

Head, thorax, and petiole subopaque, very finely shagreened; mandibles, clypeus, and frontal portion of head, but especially the frontal area, more shining. Mandibles densely striated and coarsely punctate. Legs and gaster shining, the latter finely and transversely shagreened, with the lustre of "watered" silk.

Hairs golden yellow, obtuse, suberect, and very sparse, on the upper and lower surfaces of the head, upper surface of thorax, and on the gaster. There are also a few scattered hairs on the flexor surfaces of the coxæ, femora, and tibiæ. Eyes naked. Pubescence whitish, very short and sparse, but visible on the antennæ, sides of the thorax, and on the gaster where it fails to conceal the shining surface.

Mandibular teeth and gaster black; remainder of the body and appendages deep red; antennal funiculi, legs, especially the tibiæ, mandibles, and anterolateral corners of the head, darker and more brownish. Ocellar region and mesonotum slightly infuscated even in larger workers, but there is no increased tendency to infuscation in the smaller workers.

Female. — Length, 4–5 mm.

Mandibles and clypeus like those of the worker, except that the latter is more convex and less prominently keeled. Head slender, excluding the mandibles distinctly longer than broad, with long, anteriorly converging cheeks. Thorax distinctly narrower than the head. Petiole similar to that of the worker but with sharper superior border, often slightly notched in the middle. Gaster small. Legs slender. Wings somewhat longer than the body (5.3 mm.).

Body smooth and shining, very finely shagreened, back of head and mesonotum more opaque; gaster very glabrous, being much more delicately shagreened than in the worker.

Hairs golden yellow, suberect, slender and obtuse, much longer than in the worker and more abundant, especially on the upper surface of the head and thorax and on all parts of the legs. There are a few conspicuous erect hairs along the anterior or flexor surfaces of the antennal scapes, on the lower surface of the head, and on the border of the petiole. On the gaster the long hairs are sparse and arranged in three regular rows on the first and second, in two rows on the succeeding segments.

Mandibular teeth and gaster black, remainder of body dull yellowish red. Antennæ, legs, posterior portion of head, mesonotum, scutellum, and metanotum decidedly darker. The anteromedian and parapsidal blotches are faintly indicated on the mesonotum. Wings rather opaque, grayish hyaline, with fuscous veins and black stigma.

Male. — Length, 6.5–7 mm.

Mandibles pointed, edentulous. Head short, broadest through the eyes; posterior corners broadly rounded; cheeks short, flattened, converging in front. Clypeus carinate in front, depressed behind. Thorax just in front of the wings hardly broader than the head through the eyes. There is a median longitudinal depression on the base of the epinotum, and the metanotum is concave. Petiole very thick and blunt above, anterior and posterior surfaces both convex, border with a faint median notch.

Head, thorax, legs, and antennæ subopaque, finely shagreened; mandibles, clypeus, vertex, and scutellum shining as are also the petiole and especially the gaster.

Hairs and pubescence grayish, the former short and erect on the clypeus, thorax, gaster, and legs; the latter sparse and indistinct except on the antennæ and legs. Eyes almost imperceptibly hairy.

Black; mouth-parts, legs, and genitalia fuscous. Wings like those of the female but of a slightly darker tint.

Described from numerous workers and females and two males from a single colony found near the summit of Mt. Pisgah (altitude about 1400 feet), at Colebrook, Litchfield County, Conn., and several workers taken at Black Hawk Spring, near Rockford, Ill.

F. nepticula is very closely related to the form I have called *F. microgyna* var. *nevadensis* (*vide infra*) and known only from a single female specimen from Ormsby County, Nevada. The female *nepticula* differs, however, in having much fewer erect hairs on the antennal scapes and body and, owing to the nearly complete absence of grayish pubescence, a more shining head and thorax. Moreover, the head, thorax and appendages are decidedly darker and less red than in *nevadensis*. The worker *nepticula* resembles that of *F. dryas* in coloration and the peculiar lustre of the gaster, but its average size is less, it has erect hairs on the antennal scapes, the border of the clypeus projects in the form of an angle instead of being transverse, and the epinotum is much rounder and without a flattened declivity.

The Colebrook colony of *nepticula* was first seen during August, 1904, and was mistaken for a colony of *F. dryas*, as only workers were found in the nest. They were under a large flat stone, the edges of which they had banked with vegetable débris after the manner of *F. difficilis* and its var. *consocians*. During the past summer (June 30, 1905), on again visiting the colony, I found it to contain several of the minute females (mostly callow), and was thus able to satisfy myself that it represented a distinct and undescribed species. Numerous workers, together with many cocoons, were kept for several weeks in an artificial nest. Dozens of the tiny females but only two males hatched during the first week in July. No workers hatched till July 9, when they appeared in great numbers. The small size of the female seems, therefore, to be correlated with more precocious development than in our common species of *Formica*. The movements of the workers are extremely active and petulant, contrasting with the movements of such forms as *F. integra*, *consocians*, etc., and resembling those of *F. sanguinea*. The females are more phlegmatic except when greatly excited. The approximate date of the nuptial flight is July 11. At any rate, during the early morning hours of that day most of the females managed to escape and ascended to the ceiling of the room in which I had placed their artificial nest. The diminutive size of the females strongly indicates reduced or belated fertility, so that this species, like *F. difficilis* and its var. *consocians*, *F. microgyna*, *nevadensis*, and *montigena*, very probably establishes its colony with the aid of workers belonging to some other species of *Formica*. I suspect that *F. subpolita* var. *neogagates* is the ant used for this purpose, as its workers so closely resemble the female *nepticula* both in size and coloration. I find, moreover, that a small colony of *neogagates* workers can be induced to adopt a deälated female *nepticula*.

4. **Formica nevadensis** Wheeler.

F. microgyna var. *nevadensis* WHEELER, Bull. Am. Mus. Nat. Hist., Vol. XX, Oct. 11, 1904, p. 373. ♀.

Since both the worker and female of *F. nepticula* are known, it is no longer probable that *nevadensis* should be attached as a variety to *microgyna*. The female *nevadensis* has a very smooth and shining gaster and this is probably also the case in the unknown worker, which would thus differ decidedly from the opaque-bodied worker of *microgyna*. I believe, therefore, that we are justified in raising *nevadensis* to specific rank. The discovery of the worker of this form will enable us to decide whether *nepticula* is to be regarded as an independent species or merely as an eastern subspecies of *nevadensis*.

5. **Formica impexa** sp. nov.

Worker. — Length, 3.3–6 mm.

With the habitus of *F. rufa.* Mandibles 8-toothed. Clypeus broadly rounded in front, not produced in the middle, carinate its entire length. Head, excluding the mandibles, distinctly longer than broad, even in the largest workers. Cheeks rather long, straight, subparallel. Posterior border of head straight, posterior corners rounded. Joints 1–4 of antennal funiculus decidedly longer and more slender than the remaining joints. Thorax of the *rufa* type but with the epinotum very low and rounded. Petiole rather thick antero-posteriorly, its anterior surface convex in profile, its posterior flattened, its edge, especially in smaller workers, very blunt; seen from behind it is produced upwards in the middle and of rather variable outline, being notched in the middle in some specimens, but oftener more or less rounded.

Mandibles lustrous, finely and sharply striated. Surface of clypeus uneven. Frontal area shining. Remainder of body opaque, distinctly but finely shagreened.

Whole body and all the appendages clothed with very minute white pubescence which is rather sparse on the head and thorax, but dense and concealing the ground surface on the gaster. Body, antennal scapes, and legs covered with coarse, obtuse, erect or suberect, whitish or yellowish hairs. On the gaster these are uniformly distributed and in certain lights very conspicuous. They are also very numerous and prominent on the upper surface of the thorax, clypeus, front, vertex, posterior corners, and lower surface of head, but absent or very sparse on the cheeks, pleuræ, and coxæ. On the legs they are prominent both on the flexor and extensor surfaces.

Head and thorax red. Gaster black. Even in the largest specimens, the mandibles, anterior border of clypeus, and apical half of funiculi are dark reddish brown; ocellar triangle, upper surface of pro- and mesonotum, much of the upper surface of the petiole, legs and coxæ, except their articulations, more or less blackened. Fore coxæ largely red. Anal region yellowish. In the smallest workers the infuscation is more extensive, involving the whole of the posterior portion of the head and the epinotum.

Described from twelve workers taken August 12, 1902, by Mr. O. McCreary from a colony nesting under a stone on the Porcupine Mountains in northern Michigan. Types in the American Museum of Natural History, cotypes in the University Museum, Ann Arbor, Michigan.

F. impexa is allied to *F. oreas* Wheeler and *F. microgyna* Wheeler, with both of which it agrees in having erect hairs on the antennal scapes. It differs from *oreas* in the much coarser and less abundant, erect and obtuse hairs on the head and thorax, the prominent hairs on the gaster, the longer head, more opaque surface of the head and thorax, etc. In most of these characters it also differs from the typical *microgyna.* The erect hairs on the gaster of *impexa* are much more robust and obtuse than in the latter species. The new species also resembles *F. difficilis* Emery and notably its var. *consocians* Wheeler except in pilosity.

It is probable that the female of *F. impexa* is peculiar either in being very diminutive, like the females of *F. difficilis*, *microgyna*, *nepticula*, etc., or in having an unusual color like the female of *F. oreas*. Until this sex of *impexa* is discovered there may be some doubt as to whether the form should be regarded as a species distinct from *rufa*. It certainly differs very markedly in pilosity from all the subspecies and varieties of *rufa* hitherto described.

59.82:15.6 (86)

Article XVI.—SUPPLEMENTARY NOTES ON BIRDS COLLECTED IN THE SANTA MARTA DISTRICT, COLOMBIA, BY HERBERT H. SMITH, WITH DESCRIPTIONS OF NESTS AND EGGS.

By J. A. Allen.

Five years ago, I published a list of the birds collected by Mr. Herbert H. Smith in the Santa Marta District of Colombia,[1] numbering 388 species. Later another shipment of birds was received from Mr. Smith, from the same region, containing about 350 additional bird skins and a large collection of nests and eggs, representing about 50 species. This additional material includes several species not previously represented in Mr. Smith's collections from Santa Marta, and adds seven not previously recorded from the district. There are also additional specimens of a number of species previously represented by single or very few specimens. The additional species, with a few corrections of previous identifications, are given below.

A list of the principal localities, with their location and approximate altitudes, was given in my former list of the birds (*l.c.*, pp. 123, 124) and more fully described by Mr. Smith in the introduction to my 'Report on Mammals from the District of Santa Marta' (this Bulletin, Vol. XX, 1904, pp. 413, 414).

The species now added, and the elimination of two wrongly included, raise the total number of species of birds recorded from the Santa Marta district to 392. Those here added are indicated by an asterisk (*) prefixed to the number.

Additions and Corrections.

*7 *bis*. **Hydranassa tricolor tricolor** (*Müll.*). One specimen, immature, Don Diego, May 9.

9. **Butorides virescens** (*Linn.*). One specimen, Bonda, Oct. 20. Also one specimen in the previous collections.

*44 *bis*. **Catharista urubu brasiliensis** (*Bonap.*). One specimen, Bonda, Feb. 24.

The name *urubu* (*Vultur urubu* Vieillot, Ois. d'Amér. Sept., p. 23, pl. ii, 1807) may properly be restricted to the United States form in view of the much smaller size of the South American bird, named *brasiliensis* by Bonaparte (Consp., I, 1850, p. 9). About the same amount of difference is found between the northern and southern forms of the Black Vulture as is found between the northern and southern forms of the Turkey Vulture, which latter have become recently recognized by several American writers as, respectively, *Cathartes aura aura* and *Cathartes aura septentrionalis*.

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[1] This Bulletin, Vol. XIII, Aug. 25, 1900, pp 117–184.

141. **Glaucis hirsuta** (*Gmelin*). One specimen, with nest, Don Diego, May 15. Previously recorded from Santa Marta by Bangs (*cf.* Allen, *l.c.*, p. 142).

*101 *bis*. **Ceryle inda** (*Linn.*). One specimen, female, Don Diego, May 3, 1899.

121. **Phaëthornis anthophilus** (*Bourc. & Muls.*). One specimen, female, Don Diego, May 8. Not previously received, but recorded from Santa Marta by Salvin and Godman, and by Bangs (*cf.* Allen, *l.c.*, p. 138).

145. **Tyrannus tyrannus** (*Linn.*). Eight specimens, Bonda and Buritaca, September 19 and 22, 1899. Not previously received, but recorded by Salvin and Godman from Santa Marta (*cf.* Allen, *l.c.*, p. 142).

144. **Tyrannus griseus** (*Vieill.*). A second specimen, Bonda, October 14, 1899.

*154. **Empidonax traillii** (*Aud.*). Fourteen specimens, Buritaca, September 19; Bonda, September 20–28, October 3–16; Cantilito, October 14.

These birds are all migrants, and all are referable to *E. traillii traillii*.

A re-examination of six specimens previously sent, and recorded as *E. ridgwayi* (*l.c.*, p. 144) prove to be also referable to *E. traillii*, which name should replace *E. ridgwayi* in my former list of Santa Marta birds (*l.c.*, p. 144).

266. **Dolichonyx oryzivorus** (*Linn.*). Five specimens, Bonda and Buritaca, September 20–27. Two were recorded in the former list, taken September 12 and October 12.

299. **Buarremon assimilis** (*Boiss.*). This species was recorded in error (*l.c.*, p. 167), the specimens referred to under this name being really *Arremonops conirostris caneus* Bangs.

*317 *bis.* **Hirundo erythrogastra** (*Bodd.*). Ten specimens, all birds of the year, Buritaca, September 6–29.

327. **Vireo olivaceus** (*Linn.*). One specimen, Don Diego, May 3, 1899. Not in previous collections, but recorded from Santa Marta by Salvin and Godman (*cf.* Allen, *l.c.*, p. 173).

*327 *bis.* **Vireo calidris calidris** (*Linn.*). Two specimens, Bonda, August 19, and Masinga, September 7.

These seem indistinguishable from true *calidris*, and are doubtless migrants from Jamaica, where the species is known only as a summer resident.

The specimens of *Vireo calidris barbatula*, already recorded by me (*l.c.*, p. 173) from Bonda (August 17–September 18), are indistinguishable from specimens from Cuba, where the species appears to be only a summer resident.

Since the publication of my list of Santa Marta birds, Mr. Bangs and others have described a number of species and subspecies from this region, based on material collected by Mr. Brown, and previously recorded by Mr. Bangs under other names. In referring to his earlier papers on this material, Mr. Bangs says: "Many species, however, were not satisfactorily identified, owing to lack of material necessary for comparison. Some of these have since been described, but there remain the following [four species and six subspecies]—among them, some of the best-marked forms of the region—that appear to need special names."[1] These added to the 56 species and subspecies previously based on Santa Marta specimens make 73 in a total list of 392 species and subspecies thus far recorded from the Santa Marta district, or about 19 per cent. Those published since the appearance of my former list are the following 17, all except two having been described by Mr. Bangs. They are here entered according to the numeration of my previous list, with the corresponding list names in parentheses.

1. *Crypturus soui mustelinus* Bangs (= *C. soui*), Proc. Biol. Soc. Wash., XVIII, p. 151, June 9, 1905.

104. *Chloronerpes yucatanensis alleni* Bangs (= *C. y. uropygialis*), Proc. New Engl. Zoöl. Club, III, p. 83, March 31, 1902.

109. *Nyctidromus albicollis gilvus* Bangs (= *N. albicollis*), ibid., III, p. 82, March 31, 1902.

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[1] Proc. New Eng. Zoöl. Club, III, pp 81–90, March 31, 1902.

121. *Phaëthornis longirostris susurrus* Bangs (= *P. longirostris*), ibid., II, p. 64, July 31, 1901.

160. *Onchorhynchus mexicanus fraterculus* Bangs (= *Muscivora mexicana*), ibid., III, p. 86, March 31, 1902.

176. *Myiopagis placens pallens* Bangs (= *M. placens*), ibid., p. 85.

187. *Mionectes olivaceus galbinus* Bangs (= *M. olivaceus*), ibid., p. 85.

189. *Serpophaga cinerea cana* Bangs (= *S. cinerea grisea*), Proc. Biol. Soc. Wash., XVII, p. 113, May 18, 1904.

225. *Premnoplex coloratus* Bangs (= *Margarornis brunnescens*) Proc. New Engl. Zoöl. Club, III, p. 84, March 31, 1902.

230. *Xenicopsis anxius* Bangs (= *Anabazanops striaticollis*), ibid., p. 83.

264. *Sturnella magna paralios* Bangs (= *S. meridionalis*), ibid., II, p. 56, February 15, 1901.

274. *Catamenia alpica* Bangs (= *Catamenia* sp.), ibid., III, p. 89, March 31, 1902.

316. *Chlorophonia frontalis psittacina* Bangs (= *C. frontalis*), ibid., p. 88.

317. *Stelgidopteryx ruficollis æqualis* Bangs (= *S. uropygialis*), ibid., II, p. 58, July 31, 1901.

364. *Troglodytes musculus atopus* Oberholser (= *T. m. rufulus*), Proc. U. S. Nat. Mus., XXVII, p. 207, January 23, 1904.

368. *Henicorhina hilaris bangsi* Ridgway (= *H. leucophrys*), Proc. Biol. Soc. Wash., XVI, p. 168, November 30, 1903.

369. *Microcerculus corrasus* Bangs (= *M. marginatus*, provisional), Proc. New Engl. Zoöl. Club, III, p. 87, March 31, 1902.

Descriptions of Nests and Eggs.

The collection of nests and eggs numbers about 250 entries, each entry generally including both the nest and eggs, but in a few cases there are nests without eggs, and in a number of others eggs without nests, the nest being a hollow tree or the bare ground. In about 200 cases, representing about 42 species, the identification was secured by the preservation of a bird, sent as a "marker" for the determination of the species. The identification is thus fairly positive. In some cases this precaution was not taken and the identification is unsatisfactory; all such material is omitted from consideration in the present connection.

The nests were taken and preserved with care, and the eggs, unless too far incubated, are in a good state of preservation; both nests and eggs were so well packed that they reached the Museum in excellent condition. Some of the common species are represented by large series of nests and eggs, showing the range of variation in architecture and in the shape, size, and markings of the eggs.

Especially noteworthy is the small number of eggs in a set in nearly all the species represented, two or three being the most common number, four being exceptional, and five occurring in only two species, *Icterus xanthornus* and *Cyanocorax affinis*. The bulky character of the nests is, as a rule, a striking feature, which must necessarily render them conspicuous, without, in most cases, affording any special protection from enemies.

It is interesting to note that the breeding season in the Santa Marta district is from about the first of April to the middle of June, no nests being labeled as having been taken in March, and only six later than June 15. There are four records for September, two for *Leptotila verreauxi* and one each for *Formicivora intermedia* and *Furnarius agnatus*, indicating perhaps a second breeding season for these species.

The labels rarely give anything beyond the date and place of collecting; there is unfortunately nothing to indicate the height above the ground at which the nest was placed, or the kind of tree or shrub in which it was found. The few notes found on the labels have been transcribed and are given in their proper connection, between marks of quotation.

The measurements of the eggs are in millimeters. The numbers in the numeration of the list enclosed in parentheses are those of the species in my former list of Santa Marta birds (*l.c.*).

1 (1). **Crypturus soui mustelinus** *Bangs*. Two eggs, nearly uniform ecru drab, measuring 40 × 31 and 43 × 33.5 mm. "Don Amo, altitude 2000 feet, August 6; 2 eggs on ground in a thicket." Don Amo is a plantation, in a mountain valley, 18 miles east of Santa Marta.

2 (35). **Leptotila verreauxi** *Bonap*. Twelve nests with eggs, usually two each, two nests having only one each, probably incom-

plete sets. All were taken at Bonda (altitude 150 feet), March 30, April 3, 5, 12, 13 and 18, May 1, and September 10; two sets were taken on the latter date, apparently indicating two breeding periods, a spring and a fall period.

The nest, placed in the fork of a small tree or shrub, consists of a quite substantial mass of small twigs, the amount varying considerably in different nests. The eggs are nearly pure white, slightly glossy, and vary considerably in size in different sets, an average egg measuring 30 × 22, with some as small as 27 × 20, 28 × 21, etc.

3 (37). **Columbigallina passerina granatina** (*Bonap.*). Three nests, with two eggs each, collected at Bonda, April 23, 29, and June 3.

The nests consist of a mass of small twigs and plant stems, placed in the fork of a branch or shrub. The eggs are clear white, and measure about 21 × 16.

4 (38). **Columbigallina rufipennis** (*Bonap.*). Five nests, with two eggs each, collected at Bonda, April 9 and June 2, 3, and 5.

The nests are similar in position and structure to those of the preceding species, and the eggs are apparently indistinguishable, but appear to average slightly larger.

5 (47). **Rupornis magnirostris** (*Gmel.*). Two nests, each with one egg, collected at Bonda, April 13 and 18.

The nests are rudely constructed of sticks, placed in the fork of a branch, and are rather small for the size of the bird. The two eggs vary greatly in color. The ground color is a rather dull grayish white, specked and blotched with pale chocolate, sparsely over the small end, more thickly about the middle, while the large end in one is palely washed and mottled with chocolate over the greater part of the surface; in the other, the large end is more heavily washed with a much darker shade of chocolate and heavily streaked with lines of dark umber. They measure 42.5 × 35 and 42 × 34, the eggs being oval.

6 (93). **Bucco ruficollis** (*Wagler*). Three eggs, "found in clay nest of No. 44 [*Furnarius agnatus*]." Collected at Bonda, May 17.

The eggs are clear dull white, subspherical, and measure 26 × 21, 27 × 21, 26 × 21.

7 (94). **Galbula ruficauda pallida** *Bangs*. Two eggs, without nest, Bonda, April 17.

The eggs are clear glossy white. One is broken; the other measures 21 × 18. Evidently the eggs were well advanced in incubation when taken.

8 (102). **Centurus wagleri sanctæmartæ** *Bangs.* One egg and section of a dead tree trunk, about 150 mm. in diameter, containing the nesting-hole, from Mamatoca, April 10. Egg clear white, 21.5 × 15.

9 (109). **Nyctidromus albicollis gilvus** *Bangs.* Two sets of eggs, of two each, Bonda, April 15, and Don Diego, May 15. The Don Diego set was found in a "shady place in a coffee orchard, on alluvial land, near sea-level."

The eggs are oval to elongate oval, the ground-color vinaceous buff, irregularly blotched and clouded with a darker shade of buff, interspersed with faint shades of lavender. Some of the eggs are much more heavily marked than others, in one there being a few superimposed streaks of pale hazel. In each set one of the eggs is much less strongly colored than the other. The two sets of eggs measure respectively: 30.5 × 20.5, 30 × 20.5; 31 × 21, 29 × 21.5.

10 (141). **Glaucis hirsuta** (*Gmel.*). Nest and two eggs, Don Diego, May 19. The nest, attached to the under surface of a wild banana leaf, is composed of fine vegetable fibers and partly covered externally with large strips of a greenish gray lichen. The eggs measure 15 × 9 mm., being very elongate oval, the two ends similar in form.

11 (143). **Tyrannus melancholicus satrapa** (*Licht.*). Eleven nests with eggs, Bonda, April 12, 14, 22, 24, 26, 27, and May 5, 13, 14. Two of the nests have three eggs each, one has one egg, and the other eight nests have each two.

The nests are of moderate size, with the outside diameter 120 to 160 mm.; the inside about 65 mm. Externally the nest is formed of rather coarse vegetable stems, neatly lined with finer material of the same character, the whole forming a neat, compact, substantial structure, deeply cupped, and saddled on a branch, usually at a fork, so that it is very securely supported.

The eggs are quite variable in size, ground-color, and markings. In an average set, the ground-color is very pale buffy white, blotched with dark chocolate, sparsely at the ends, but heavily about the middle, the large blotches often extending nearly to the larger end. The ground-color varies in different sets from nearly clear white to deep pinkish buff, and the blotches from chocolate to blackish. The eggs vary in measurements from 22 × 15 to 24 × 18.5.

12 (148). **Myiarchus erythrocercus** *Scl. & Salv.* Two nests and six sets of eggs, Bonda, April 8, 9, 12, 19, and May 2, 20. "Nests in hollow tree."

One of the nests is *in situ* in the hollow top of a dead stump, about one foot below the top of the stump. So far as can be determined without removal from the stump, it consists of a felted mass of soft materials lining the bottom of the cavity. The other nest, removed from the nesting cavity by the collector, consists chiefly of hair, with a few green parrot feathers and bits of snake skin, the latter a usual component of the nests of various species of *Myiarchus*.

The number of eggs to the set varies from two to four, one set containing four, two sets two each, and three sets three each. They are of the usual *Myiarchus* style, the ground-color being creamy white, profusely marked with narrow longitudinal streaks of purplish chocolate, most heavily at the larger end. There is a wide range of variation in the amount and color of the markings, in some of the eggs the streaks covering much more than half of the surface, while in others much the greater part of the egg is white. Average eggs measure 22 × 17, 22 × 16, 24 × 17, etc.

13 (152). **? Contopus brachytarsus** (*Sclater*). Four nests with eggs and four nests without eggs, some of the latter old and weathered, the first four (with eggs) collected at Bonda, April 16, 25, 29, and May 1. Unfortunately the nests lack identification through the presence of any parent bird, but both the nests and eggs are so similar to the well-known nests of North American species of the genus that they apparently cannot be those of any other species, this being the only species of *Contopus* breeding in the region.

The nests are all saddled on the upper side of a nearly horizontal branch at a point where the branch forks. The nest proper is formed of circularly woven plant fibers, and heavily lined with rather large coarse white feathers, mainly of some species of pigeon, while the exterior is heavily coated with white or light-colored flaky vegetable substances which differ in character in different nests but result in the same general effect, which is that of the lichen-covered nest of *Contopus virens*. In one nest, bits of greenish gray lichen are actually used to partly cover the outside, while in others bits of cloth, cotton thread, and plant down are used. The edges of the nest where it comes in contact with the main branch or with the forks between which it is placed are, in the fresh nests, plastered to the bark, evidently by some glutinous secretion supplied by the bird. The outside diameter of the top of the nest is usually about 3½ to 4 inches (85 to 105 mm.), with an inside diameter of 2 inches (50 mm.); the depth of the cup is about ¾ of an inch to an inch (19 to 25 mm.).

The eggs are creamy white, blotched and speckled with reddish chocolate and lavender, chiefly in a ring near the greater end of the egg. The number of eggs in three sets is two each, in the other, three. A set of two eggs measures 15 × 19 and 15.5 × 20; the single egg, 16 × 21.

14 (161). **Megarhynchus pitangus** (*Linn.*). Fifteen nests, each with two eggs, except two, one of which has three and the other four, all taken at or in the immediate vicinity of Bonda, April 7 to May 3.

The nests are massive, domed structures, with the entrance on one side near the top. They are globular in general outline, varying in size from about 10 to 15 inches (250–380 mm.) in diameter, and are placed in the upright forks of branches. They are constructed externally of coarse grass stems, long pieces of vine stems, and other coarse vegetable fibers, with a globular inner nest of finer materials, all compactly and firmly woven together. The materials vary considerably in the different nests, which also vary in size, those made of the finer materials being smaller than those constructed of coarser materials. Their large size must make them very conspicuous objects, but their thick walls must secure considerable protection from enemies.

The ground-color of the eggs is creamy white, varying somewhat in the depth of tone in different sets of eggs, sprinkled with dots and small blotches of rich chocolate and lavender, mostly about the greater end, but more or less scattered over the whole surface. The markings vary in size and abundance in different specimens, sometimes forming simply a circle of large blotches around the point of the greatest diameter of the egg, with the rest of the surface nearly free from markings; in other cases the whole surface is more or less marked with specks and spots, without forming a very distinct ring near the greater end.

Three sets of eggs measure as follows: 27 × 19.5, 28 × 20, 29 × 20; 28.5 × 20.5, 29 × 21; 29 × 19.5, 31 × 20.7.

15 (162). **Myiodynastes audax nobilis** (*Sclater*). One nest and three sets of eggs, with respectively one, two, and three eggs each, Bonda, May 9, 10, 11.

The nest is a thick layer of leaf stems (petioles of an unknown plant), hollowed to form a receptacle for the eggs, and was "taken from a hollow in a dead tree." The other two sets of eggs are labeled: "Nest in hollow of a tree. Not preserved."

The eggs have a nearly white ground-color, heavily blotched all over with reddish chocolate and lavender, covering nearly the whole surface. The eggs in general appearance resemble those of species of *Myiarchus*, but the markings are more rounded and less linear. In one set the spots are much more abundant about the larger end of the egg than elsewhere, the eggs of different sets varying considerably in the arrangement and extent of the markings.

The eggs measure as follows: 24 × 17.5, 24 × 17.5, 25.2 × 18.3; 26 × 18.5; 25.5 × 18, 26 × 18.5.

16 (167). **Rhynchocyclus flaviventris** (*Wied*). Nineteen nests, of which one has one egg, thirteen have two eggs each, and five have three eggs each. All were taken at Bonda, as follows: April 22, 28, May 6, 16, 20, 24, 26, June 1, 2, 3, 5, 6.

The nest is retort-shaped, hung apparently from the end of a slender, drooping branch, with the entrance at the bottom. It is compactly woven of soft flexible fibers of dead grass, coarse at the top and superficially but, for the most part, very fine and soft, in some nests almost as fine and soft as tow. The entrance forms a short neck at the bottom on one side, through which the bird passes upward to the nest proper, which occupies the bulbous portion of the bottom. The nest is supported and fastened to the branch by quite a long, slender, tapering neck. The nests vary in vertical length from about six inches to a foot, according to the length of the neck, with a diameter across the bulbous portion, near the bottom, of about four to six inches.

The eggs, usually two or three to the set, have the ground-color creamy white, with a few small, scattered, roundish spots of dark chocolate, varying from reddish brown to blackish brown, clustered mostly about the greater end. The eggs are rather pointed ovate, and measure in the average about 14 × 7.5.

17 (169). **Myiozetetes similis colombianus** (*Cab. & Heine.*). Thirteen nests, of which one has one egg, seven have two eggs each, four have three each, and one has four. They were all taken at Bonda, and all but one in April (April 7–27), the other bearing date May 13.

The nest is a domed structure, large for the size of the bird, placed in the fork of a branch. It is composed of dead grass, usually of a reddish brown color, with numerous conspicuous tufts of white cotton woven into the base and sides. In some cases cotton forms the greater part of the exterior, while in other nests very little is used, but usually it is a conspicuous feature of the structure. In one case, the soft downy substance is not cotton, but is of a silky texture, very soft, and more or less yellow, or even reddish, in color, it being the soft down of some other plant than cotton. The inside or lining of the nest is fine vegetable fibers, without any plant down, which is all applied to the outside of the nest instead of being utilized as a soft lining. The opening is large, circular, and occupies the greater part of one side of the nest. The general form of the nest is nearly spherical or globular. The vertical diameter of the nest is about 6 to 8 inches, with a transverse diameter of about 4 to 6 inches, the size varying considerably in different nests.

The eggs are ovate to elliptical ovate, with the ground-color nearly clear white, sparingly marked with small spots of brown and lavender, the spots being larger and more crowded about the larger end. They vary considerably in size and form, even in eggs of the same set, as shown by the following measurements: 21.5 × 16, 22.5 × 16, 22 × 16, 23.7 × 16.5, 24 × 16, 23 × 15.

18 (173). **Elænea pagana** (*Licht.*). One nest, with two eggs, taken at Bonda, April 16.

This nest is suspended against a small upright branch, to which it is fastened strongly on one side at the top only. It has the form of an inverted, short-necked retort, with the entrance at the bottom, on one side, produced to form the neck of the retort. The exterior is composed of a thin layer of stiff, fine, black vegetable fibers, by means of which and a few coarse grass leaves it is bound on one side to the upright twig that gives it support. The inner part or main body of the nest is woven of coarser vegetable fibers of a different color, with much cottony plant down woven in around the entrance. Three small leaves are attached to the exterior, being held in place by the horse-hair-like fibers that compose the exterior. The length of the nest (vertically) is about 5 inches, the transverse diameter about 3½ inches.

The eggs are grayish white, nearly covered with specks and blotches of very dark brown and lavender, the egg thus greatly resembling those of the North American Oven-bird (*Seiurus aurocapillus*). The form of the eggs is short ovate, they measuring

18 × 13.5. They are unfortunately in bad condition, evidently having been far advanced in incubation when collected.

19 (193). **Euscarthmus impiger** *Scl. & Salv.* Eight nests, taken at Bonda, May 5–28 and June 2. Three are without eggs, one has one egg, three have two eggs each, and one has three eggs.

The nests are suspended from a drooping twig, of a shrub or herbaceous plant, to which they are very strongly attached by the twig being heavily enclosed in the substance of the upper part of the nest, which sometimes forms a pointed projection upward beyond the main body of the nest. The small circular entrance, however, is on the side, near the top of the nest, instead of at the bottom through a slightly produced tube, as in *Elænea*, *Todirostrum*, *Rhynchocyclus*, etc. Externally the nest is formed of blades of dead grass and finer vegetable shreds and fibers, lined with a large quantity of soft plant down, varying in color from soiled white to deep rusty buff. In some instances the nest consists principally of plant down, mixed, especially externally, with enough fibrous material to give firmness.

The vertical length of the nest proper is about 4 to 4½ inches, with sometimes in addition a pointed projection upward, forming the attachment, one to two inches in length. In other cases support is obtained by simply weaving into the outer wall on one side the slender plant stems or twigs to which it is fastened.

The eggs are clear dull white, nearly unspotted, or with only a few widely scattered rusty specks near the greater end. They measure about 18 × 13.

20 (195). **Todirostrum nigriceps** *Sclater.* One nest, with one egg, Bonda, June 6.

This is a globular nest, with the upper surface firmly attached to a twig, and the entrance on one side at the bottom, forming a slightly projecting neck. It is composed of rather fine grass-like plant fibers, a considerable layer of which is carried over the top of the twig which gives the nest its support. The whole material of the nest is soft, of a yellowish brown color, interwoven with which is more or less whitish plant down, which is mixed to a considerable extent with the soft fibrous material that constitutes the lining. The transverse diameter at the bottom is about 4 inches, the vertical about 3½ inches.

The egg is regularly ovate, clear white, with a few yellowish brown or rust-colored specks over the larger end. It measures 16 × 11.

21 (200). **Sayornis cineracea** (*Lafr.*). One nest with three eggs, taken three miles east of Bonda, June 5.

The nest is much like that of our Phœbe (*Sayornis phœbe*), having the external and basal portions formed of mud, with the nest proper composed of fine dry grass and other plant fibers, mixed with plant down and a few feathers. The external diameter is 4 inches, the internal 2 inches.

The eggs are clear dull white, unspotted, and measure 20 × 14 and 20 × 14.5 (one is broken).

22 (209). **Pachyrhamphus cinereiventris** *Sclater.* Two nests, one without eggs and the other with three; Cacagualito (altitude, 1500 feet), May 20, and Bonda, June 1.

These nests are very massive, placed in a stout upright fork of a shrub or tree, and composed of dry brown grass, plant stems, strips of bark, etc., mixed with much yellowish plant down. They are very deep, open at the top, with the nest cavity extending nearly to the bottom of the nest, which may have a depth (vertical length) of 9 or 10 inches, with the cavity extending to within an inch or an inch and a half of the bottom, and without any lining of soft materials. One of the nests is much more bulky than the other, having a transverse diameter of 7 inches, instead of only 5, as in the other.

The eggs are grayish white, thickly streaked, blotched and spotted with dark lavender, and with a few overlying streaks and spots of dark chocolate. In one egg the streaks and spots are more sharply defined and darker than in the other two. Size, 19 × 14.

23 (152). **Manacus manacus abditivus** *Bangs.* One nest, with two eggs, Don Diego, May 18.

This is a small, shallow, cup-shaped nest, attached by the rim to the forks of a small horizontal twig, the branches of which on two sides are built into the rim. The nest is so thin that the eggs are clearly visible through it from below, and is composed of long wiry grass stems or other plant fiber, neatly woven to form the circular nest. Its attachment to the twigs, at the outer edge, is effected not merely by weaving the plant fibers about the twig, but by the use of spider web, matted to the plant fibers by use of some glutinous matter, probably secreted by the bird. The transverse diameter of the rim is about 3 inches outside and 2 inches inside, with an inside depth of about 1 inch.

The egg has the whitish ground-color nearly covered with longitudinal streaks of pale yellowish brown, with, in places, a slight wash of lavender, the markings, except over the small end, occupying nearly the whole surface, with fainter interspaces between the heavier blotches. Size, 20 × 14.5.

24 (216). **Chiroxiphia lanceolata** (*Wagler*). Three nests, with eggs (1, 2, 2, respectively), Bonda, May 16, 18, 24.

The nests in a general way resemble the nest of *Manacus*, already described, from which they differ in being made of finer materials and in being more compactly built, with the bottom less open, and reinforced with an exterior covering of leaves. They are all attached by the rim to the twigs of a horizontally forked branchlet, and are composed of circularly woven plant stems (apparently, in large part, long slender petioles), with an outside covering of small dead leaves, sufficient in one nest to entirely cover the nest externally below, and nearly so in another. The rim of the nest is in each case bound to the supporting twigs mainly by a whitish mass of spider web held together apparently by the dried glutinous saliva of the bird, as in *Manacus*. The outside diameter across the rim is 2½ to 3 inches, the inside diameter about an inch less, and the depth of the cavity less than an inch.

The three sets of eggs, while they have a mutual general resemblance, differ greatly in details of coloration, as do also the eggs of the same set. In one set the ground-color in one egg is dull pale creamy white, while in the other it is a much deeper shade of the same color; in the other eggs it is of about the same shade as in the paler egg of this set. The markings, generally of a very pale chocolate mixed with lilac shades, in the first set nearly cover the eggs, especially in the darker egg, while in the other set of two eggs they are sparser and coarser; in the single egg of the other set they are nearly all massed in a nearly solid broad ring about the greater end of the egg. Size, about 22 × 15.5, 21 × 14.7, 21. 5 × 15.

25 (223). **Dendroplex picirostris** (*Lafr.*). One nest with three eggs, Bonda, June 18; also a set of three eggs, Bonda, June 17.

An abandoned woodpecker hole in the top of a dead stump appears to have been utilized for a nesting-site, the nest consisting of a felted lining of plant down mixed with bits of plant stems at the bottom of the cavity.

The eggs are clear white, smooth, and slightly polished, and measure as follows: 26 × 13, 27 × 13.5, 27 × 14.3; 25 × 14.6, 26 × 15, 25 × 14. In one set the greatest diameter is at the middle, in the other nearer to one end.

26 (241). **Furnarius agnatus** *Scl. & Salv.* Two nests, with two eggs each, Bonda, May 15, September 18.

The nests are of the usual *Furnarius* type, made of layers of mud and saddled on a branch of a tree, forming a rounded, domed structure, with the entrance at one side near the bottom, communicating with an interior nest-chamber, lined with plant stems, apparently mostly petioles of leaves. The nests are about 8½ to 9 inches high, and about the same in diameter.

The eggs are clear white, elongate oval, and measure 24.5 × 17.5, 25 × 17.5, 25.5 × 18, 25 × 18.4.

27 (248). **Formicivora intermedia** *Cabanis.* Three nests, with two sets of eggs of two each, Bonda, April 21 (nest only), May 15, and September 18.

These nests are slight, pensile structures, suspended by the rim from the forked twigs of a horizontal branch. They consist of fine wire-like plant fibers, probably grass stems, loosely woven to form the deep cup-shaped nest, which is fastened to the twigs by looping some of the fibers over them. They are so slight and open that the eggs are plainly visible through the walls and bottom of the nest. They have an outside diameter of about 3 to 3½ inches, and a depth (inside) of about 2 inches.

The eggs are grayish white, thickly sprinkled with dots and small spots of lilac, with a few specks and blotches of very dark chocolate intermingled, the markings about the larger end almost wholly covering the surface. Measurements, 19 × 13 (average of four eggs).

28 (252). **Thamnophilus melanonotus** *Sclater.* One nest, with two eggs, Bonda, May 12.

The nest is similar in position, structure, and materials to the nests of *Formicivora intermedia*, but is of course larger, having a diameter across the rim of about 3½ inches and a depth of 2½. It is suspended by the rim to the fork of a small thorny branch, and is rather openly woven of some species of wire-like grass and coarser plant stems, without lining, but decorated on the outside with scattered tufts of plant down.

The eggs are white, with profuse markings of prune purple at the greater end, which in one egg nearly cover the surface, but are much more sparse on the other egg; the pointed half is without spots in both eggs. The eggs are both badly broken; the measurements of one can be given as 26 × 14.

29 (257). **Cyanocorax affinis** *Pelzeln.* Eleven nests, with three to five eggs each, all taken at Bonda, April 5–25 and May 2 and 15.

The nests are bulky structures of sticks and coarse twigs, lined with finer twigs, placed in the fork of an upright branch. They are of the usual Jay style of architecture, but differ much among themselves in the character of the materials utilized, some being constructed externally of very coarse sticks, the largest of which have a diameter of 5 to 7 mm., while others are built wholly of fine twigs, and thus are much smaller and more artistic, with a breadth of about 9 inches, instead of 12 to 14 as in the nests of coarser material. In all the lining consists merely of fine twigs.

Of the eleven sets of eggs, five have three eggs each, four have four each, and two have five each. The number of eggs to the set is thus exceptionally large for a bird of this region. The buffy white ground-color is nearly concealed by spots and blotches of olive brown, tinged more or less with grayish. A set of five and another of three eggs measure as follows: 29 × 22, 33 × 23, 33.5 × 23.2, 33 × 23, 33 × 23; 33 × 25, 32.5 × 23.6, 35 × 24.

30 (260). **Icterus xanthornus** (*Linn.*). Seventeen nests, with eggs, all from Bonda, of which fifteen were taken in April (April 5–21) and two in May. Six of the nests contained two eggs each, ten contained three each, and one had five, "the only nest in which five were found."

These nests are of the usual pendant, *Icterus* style, with the entrance at the top, but they vary considerably in length and in the character of the materials used in their construction. They are composed principally of grass, but vary in color, being dull grayish brown, yellowish brown, or even bright reddish brown, according to the kind of grass selected. One differs from all the others in being composed of a much finer and more wiry kind of grass than the others. They are all very compactly woven, the walls gradually thickening from the top to the bottom, the bottom being from one-half to three-fourths of an inch thick, within which is a circularly woven thick lining of softer material than the walls, forming a sort of second nest at the bottom of the pouch. The nests vary in length from about 10 to 16 inches, with a diameter at the bottom of about 4½ inches.

The eggs are white, sometimes bluish white, scrawled with lines of purplish black, and sometimes with lavender, chiefly about the greater end, the amount of marking varying greatly in different sets, and even in different eggs of the same set. Two sets, of three and five eggs each, measure: 25 × 17, 25 × 16.5, 24.7 × 16; 25 × 16.5, 26 × 17, 25 × 16.2, 26 × 15.5, 25 × 17.

31 (265). **Molothrus cassini** *Finsch.* Six eggs, laid in the nests of various other species, unfortunately not identified by the collector. They are of the usual *Molothrus* style, white, thickly speckled with reddish brown. Size, about 23×17 to 25×18.

32 (273, 299). **Arremonops conirostris caneus** *Bangs.* Four nests, each with two eggs, Bonda, April 18, 19, 22, and May 4.

The nests, bulky and deeply cup-shaped, are placed in the fork of a branch, and differ much in the materials of which they are constructed. One is composed outwardly of dead leaves, lined with plant stems and fine tendrils of some vine. Another is composed outwardly and also lined with pieces of broad leaves of some sedge or flag, mixed with plant stems, the latter forming a sort of middle layer. Another is composed externally of fine grass leaves, and internally of broad blades of grass or sedge and fine plant fibers. In position, form, and in general structure the four nests are all very similar. Their external diameter is about 5 inches, internal about 3; depth externally 4 inches, depth of cavity about 2½ inches.

The eggs are pure white and measure (two sets): 23 × 17, 23 × 17; 24 × 17, 23.5 × 17.

33 (286). **Volatina jacarina splendens** (*Vieill.*). Two nests, one with one egg and one with two, and an additional set of two eggs, collected at Bonda, May 6 and June 2.

The nests are placed in the fork of a small branch, and are deeply cup-shaped, compactly woven of fine plant fibers and lined with finer material of the same character. Outside diameter, 3 inches; inside diameter, 1¾; inside depth (in the best-preserved nest), ½ inch. "Nest in a shrub, second growth."

The eggs are pale bluish white, in one set nearly clear white, sprinkled with small spots of reddish chestnut, massed chiefly around the greater end. Measurements: 15.5 × 12, 14.7 × 11.7; 15.5 × 13, 18 × 13; 16 × 12.

34 (296). **Saltator olivaceus** *Cab.* Seven nests, each with two eggs, Bonda (or immediate vicinity), April 12–25, and May 3 and 8.

The nests are large, bulky structures, rather rudely constructed externally of sticks and plant stems often intermixed with leaves and long strips of a broad-leaved sedge (one nest is almost wholly composed of the latter), and lined with finer plant stems, sometimes with wire-grass. The nests vary greatly in size and materials; one has a part of a letter or other manuscript, in Spanish, placed among the leaves forming the outer wall of the nest. The smaller nests have an external diameter of about 5 inches, in others it is 6, 8, and 9 inches, not including the projecting ends of some of the coarser sticks. The inside diameter is about 3 inches, with an inside depth of 1½ to 2 inches, and an external depth of 3 to 5 inches.

The eggs are pale blue, with fine lines, like pen-scratches, of black, mostly confined to the larger end. Two sets measure: 27 × 13, 27 × 12.5; 25 × 14, 26 × 14.

35 (306). **Ramphocelus dimidiatus** (*Lafr.*). Five nests, of which four have two eggs each and the other one egg, Cacagualito (altitude, 1500 feet), May 12 (one nest), and Don Diego (coast region, 45 miles east of Santa Marta), May 5–18.

Several of these nests are detached, but are labeled as found "on a coffee tree," and were evidently placed in the fork of a branch. They are compact nests, deeply cupped, with rather thick walls, composed externally of plant stems and lined with finer stems and wire-grass. Some have leaves of shrubs and bits of broad graminaceous leaves, somewhat resembling maize leaves, woven into the outer surface. The external diameter at the upper edge is about 5 inches, the internal about 2½, and the inside depth about 2 inches.

The eggs are blue, finely spotted with light and dark chocolate over most of the surface, but with the spots generally larger and more numerous about the larger end. Average eggs measure 23 × 16.

36 (309). **Tanagra cana** *Swains.* Six nests, four of which have two eggs each, and of the two others, one has three eggs and the other one; four are from Bonda, April 20–24, and one each from Masinga (May 14) and Mamatoca (May).

The nests, placed usually on the fork of a small horizontal branch (one is on an upright fork), are compact and neatly built, forming a deep cup with very thick walls, of rather fine vegetable fibers mixed copiously with plant down, and in one case with ravelings, bits of cloth, and a little wool, and several have a few feathers; one has the whole outside covered with cotton; another has as a prominent feature bits of gray and green cloth; others are almost wholly without any of these conspicuous accessories. An average nest has an external diameter of about 5 inches and an external depth of 4 inches; inside diameter, 2 inches; inside depth, 1¾ inches.

The eggs are faintly bluish white, rather heavily streaked and spotted all over with lavender and blackish chocolate, the former predominating, the markings generally covering the greater part of the surface of the eggs. In some sets, however, the markings are much less abundant, covering less than half the surface. Four eggs, selected at random, measure 24.5 × 15.5, 22 × 16, 25 × 16, 25 × 17.

37 (315). **Euphonia trinitatis** *Strickl.* One nest, with two eggs, Bonda, April 24.

The nest is suspended by the rim from the fork of a small branch, and is a rather slight structure, woven of grass blades and lined with a few plant stems, the supporting twigs being woven into the rim of the nest on two sides. The nest is so thin and slight that the eggs would be partly visible from below. It measures 4 inches across the top, with the cavity only about half an inch deep.

The two eggs have a faintly bluish white ground-color, almost uniformly speckled all over with dots and small spots of chestnut, but with the larger spots chiefly at the larger end of the egg. They measure 14.5 × 11, 15 × 11.

38 (324). **Vireo chivi agilis** (*Licht.*). Two nests, each with two eggs, Bonda, May 16 and June 2.

These nests are of the typical *Vireo* style, being suspended from a fork of a horizontal branch, the twigs supporting them being woven into the rim of the nest. They are composed of grass blades and soft vegetable fibers, mixed with a little plant down. They have an outside diameter across the rim of 3 inches, and an outside depth of 2¼ inches, with thick, substantial, neatly constructed walls; inside diameter, 2¼ inches; inside depth, 1½ to 1¾ inches.

The eggs are white, with a few blackish dots, mostly about the larger end. One set is broken; the other measures 20 × 15, 19 × 15.

39 (368). **Henicorhina hilaris bangsi** *Ridgway.* One nest, with parent bird, but no eggs, Valparaiso (altitude 5000 feet), June 1.

Nest pensile, with the opening near the top, composed of stiff black wiry rootlets, uniform in structure and materials throughout, except that there are patches of green moss affixed here and there to the outside. At present, it does not nearly cover the whole outer surface, but some may have been lost.

40 (371). **Heleodytes griseus** (*Swains.*). Two nests, with four and three eggs respectively, and two additional sets of eggs of two each, Bonda, April 1, 12, 21, and 29.

The nest is built in the fork of a bush, and consists of grass, flag leaves, soft, more or less disintegrated vegetable fiber of various kinds, forming a mass some 15 inches deep and 7 inches in diameter in one nest and 10 in the other. One of the nests is heavily covered on one side with raw cotton fiber; the other is without cotton. The entrance is near the top of the nest, on one side.

The eggs, while all of the same style and evidently of the same species, vary greatly in the tone of the ground-color and in the color of the markings, the ground-color varying from nearly white to cream-color, and the markings in the palest set, are very pale lavender, deeper lavender in another set, and olive brown in the darkest set. In one set, they are pinkish lavender. The markings, very fine and more or less blended, cover almost uniformly the whole surface of the egg. The four sets measure: 21.5 × 14, 23.5 × 16, 24.3 × 16; 23.5 × 17, 24.5 × 17.3; 25.2 × 17, 25.7 × 17; 24 × 17, 24.2 × 17, 25.2 × 17, 24.6 × 17.

41 (381). **Merula grayi lurida** (*Bonap.*). Eleven nests, each with eggs, Bonda, April 8, 15, 22, 26, May 4, 6, 7, 11, 15, 18, 23. Six of the nests have two eggs each, three have three each, one has four, and one has one.

The nests are solidly built of mud, plant roots, and stems, and are of the typical *Merula* character. The amount of mud used varies in different nests, as does the size of the structure. The average outside diameter is about 5 inches, and the outside depth the same; inside diameter, 3½; inside depth, about 2 inches.

The eggs are pale blue, thickly spotted and blotched over the larger end with reddish chestnut, and sparingly over the rest of the egg. The eggs vary greatly in the tint of the ground-color, and also in the amount of spotting, and also in size, as shown by the following measurements of five sets: 28 × 20, 28 × 19.5; 25.5 × 18.5, 25 × 18.5, 26 × 18.5, 25 × 18; 28 × 18.2, 26 × 20; 27.5 × 19, 27 × 19; 28 × 20, 26.5 × 18, 26 × 18.5.

42 (382). **Merula albiventris fusa** *Bangs.* Three nests, each

with eggs, Bonda, April 27, May 15, June 15. In two sets there are two eggs each; in the other, three.

The nests are similar to those of *Merula grayi lurida*, the three nests differing as much among themselves as do any of them from average nests of *lurida*.

The eggs also are not certainly distinguishable in color or form from those of *lurida*, there is so much individual variation in each series. They average, however, decidedly larger, as shown by the following measurements of the three sets: 28 × 19.5, 29 × 20; 29 × 20, 29 × 21; 30 × 19, 31 × 17.5, 31 × 19. The eggs of this last set are abnormally elongated and narrow.

56.34 (114:77.2).

Article XVII.—DESCRIPTIONS OF NEW FOSSIL SPONGES FROM THE HAMILTON GROUP OF INDIANA.

By R. P. Whitfield.

Plates IX–XI.

Among the numerous fossils purchased from Mr. G. K. Green, of New Albany, Indiana, there is a series of fossil sponges from the Hamilton Group, at and near Speed's quarry, in the vicinity of Charlestown, Clark Co., Indiana, that appears not to have been noticed by any one up to the present time, as I can find no generic or specific names under which the forms can be readily or satisfactorily placed. They comprise three distinct types, or generic groups; although associated together and in the same state of preservation, they are probably fundamentally distinct from each other. All are so thoroughly silicified that none of the microscopical features of their structure can be obtained; in fact, they are often completely agatized.

One of the forms presents a somewhat similar appearance to that which is often seen on a species of Favosite that has been deformed by severe compression in a soft matrix, retaining the semblance, however, of a group of tubes or cells, but without distinctive specific characters. This form rather closely resembles the figures of *Somphospongia*, as given by I. W. Beede, in Vol. VI of the Kansas Geol. Report for 1900, plate ii, figs. 1–5. It also appears to be fully as diverse in form as that one.

A second form among them is usually conical, often highly so, though sometimes almost flat; the upper surface being finely pitted and sometimes indistinctly striate radially, especially on the under side around the edge and near the base of the cone. This form is quite generally attached to the upper valve of a species of *Discina*-like shell, resembling *Roemerella grandis* Vanuxem but usually more elevated. The structure of this sponge (if it be a sponge) is very compact, and the substance is so thoroughly replaced by silica as to entirely obliterate all other internal features. If turned upside down it might readily be mistaken both in form and surface marking for *Palæomanon cratera* Roemer, from the Silurian strata of Perry County, Tennessee.

The third form differs again entirely in its general structure and surface features. It is as multiform in shape as the first mentioned, being irregularly spherical, conical, or depressed convex. One species is dactyloid. The surfaces of all, however, present the same characteristic, namely, that of looking as if one had gathered together the castings of an earthworm from soft mold and pressed them into shape without destroying entirely their vermiform appearance. Hence the name *Vermispongia*.

Vermispongia, gen. nov.

Bodies more or less spherical in form, conical, compressed spheroidal, or occasionally flattened. Composed of partially isolated particles, which resemble the castings of earthworms closely pressed together, forming irregularly shaped masses without entirely destroying their cylindrical form. The individual masses bear evidence of attachment to foreign bodies.

Microscopical features of the skeleton not obtainable. Geological horizon Hamilton Group.

Vermispongia hamiltonensis, sp. nov.

PLATE XI, FIGS. 1–5.

Species extremely various in form, generally of a more or less compressed spheroidal shape, and quite frequently showing evidence of attachment to some foreign body, generally the shell of a brachiopod. The outer surface presents the appearance of being composed of loose, string-like material closely compressed into rounded masses, as if a group of the castings of earthworms had been pressed into this shape without entirely destroying the cylindrical form.

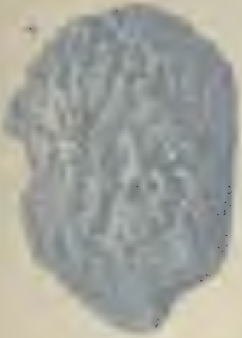
Many of the specimens in the collection show on their under surface remains of the shells of *Strophæodonta*, *Chonetes*, and one of *Roemerella grandis*.

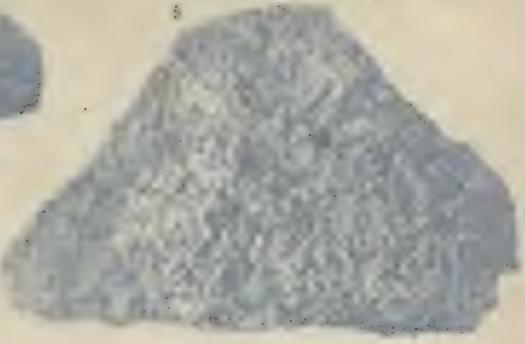
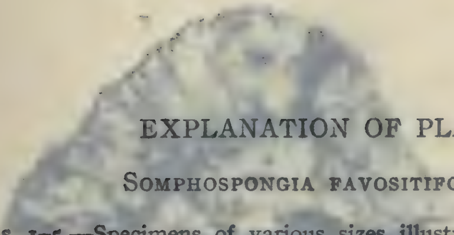
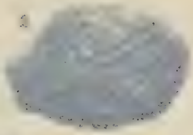
Vermispongia dactyliformis, sp. nov.

PLATE XI, FIG. 6.

A single individual of what would appear to be a distinct specific form occurs in the collection. It is two and a half inches long (10½ cm.) by seven-eighths of an inch wide (13½ mm.) in its flattened condition. The surface presents almost the same appearance as those of the last species, but has been worn slightly and in this condition looks extremely like the figures of *Streptosolen*, given by Mr. E. O. Ulrich in Vol. VIII of the Illinois Geol. Surv. Reports, plate iv, figs. 4 and 4*a*, but I have concluded to place it under the above named genus in preference. The geological horizon of the specimen is established by the fact that it bears the markings of *Strophæodonta perplana* and *Chonetes lepida*, and that attached to it is a small cheek plate of a *Prætus*.

The second form mentioned is so closely similar in its external features to one figured by Mr. E. O. Ulrich in Vol. VIII of the Illinois



EXPLANATION OF PLATE IX.

SOMPHOSPONGIA FAVOSITIFORMIS, sp. nov.

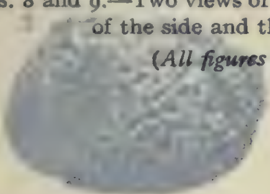
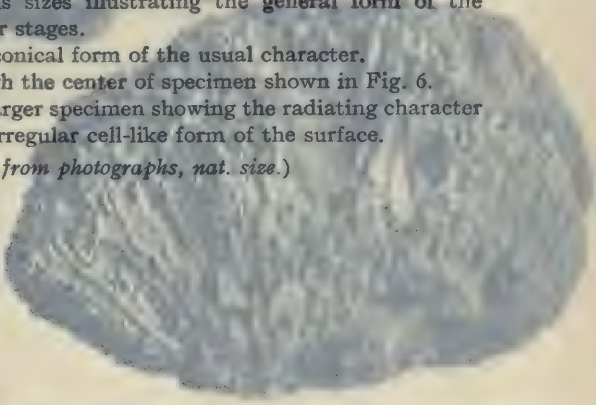
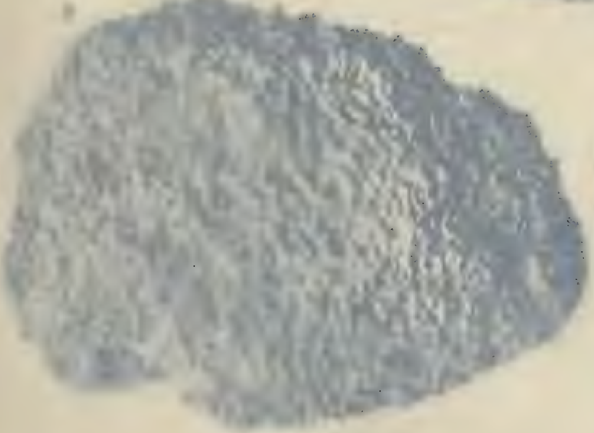
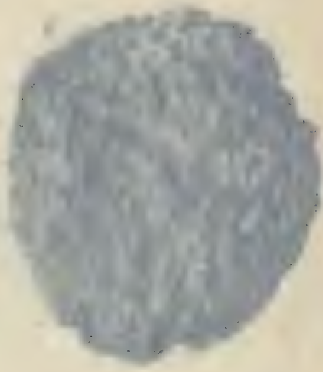
FIGS. 1–5.—Specimens of various sizes illustrating the general form of the species in its younger stages.

FIG. 6.—Lateral view of a large conical form of the usual character.

FIG. 7.—View of a section through the center of specimen shown in Fig. 6.

FIGS. 8 and 9.—Two views of a larger specimen showing the radiating character of the side and the irregular cell-like form of the surface.

(*All figures are from photographs, nat. size.*)

surface features. It is as variable in shape as the first mentioned, being irregularly spherical, conical, or depressed convex. One species is described. The surfaces of all, however, present the same characteristic, namely, that of looking as if one had gathered together the castings of the earthworm from soft mold and pressed them into shape without destroying entirely their vermiform appearance. Hence the name *Vermispongia*.

Vermispongia, gen. nov.

Bodies more or less spherical in form, conical, compressed spheroidal, or occasionally flattened. Composed of partially isolated particles, which resemble the thin castings of earthworms closely pressed together, forming irregularly shaped masses without entirely destroying their cylindrical form. The individual [illegible]

Microscopical [illegible] not determinable. Geological horizon, Hamilton Group.

[illegible] spheroidal [illegible] foreign body, [illegible] the appearance of being [illegible] into rounded masses, as [illegible] pressed into this shape [illegible]

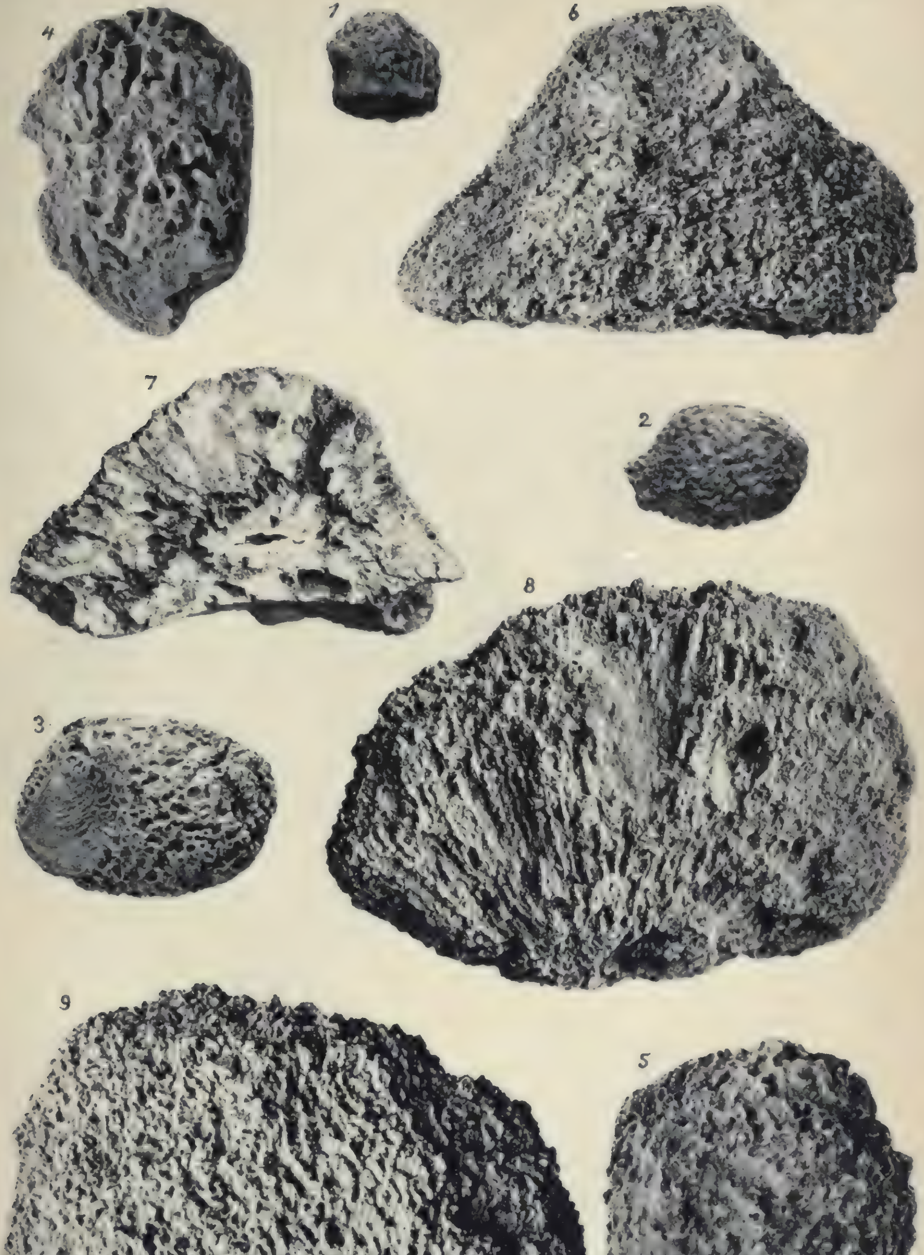
Many of the specimens in the collection [illegible] surface [illegible] of the shells of [illegible]

Vermispongia [illegible], sp. nov.

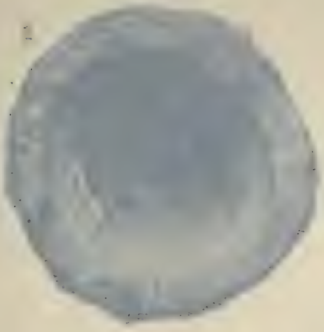
Plate XI, Fig. 6.

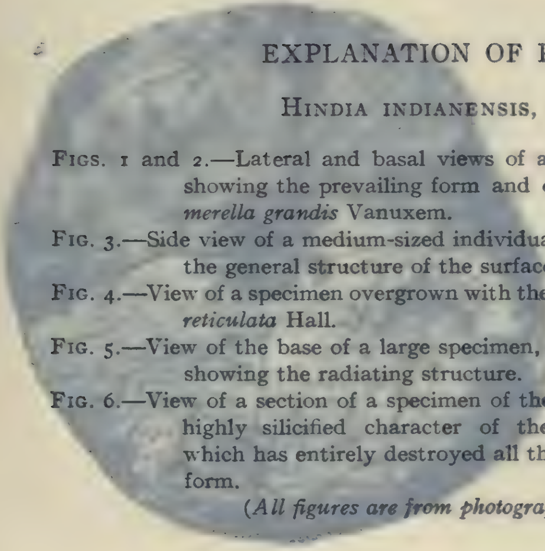
A single individual of what would appear to be a [illegible] in the collection. It is two and a half inches long [illegible] of an inch wide (13½ mm.) in its flattened condition. The surface presents almost the same appearance as those of the last species, but has been worn slightly and in this condition looks extremely like the figures of [illegible], given by Mr. E. O. Ulrich in Vol. VIII of the Illinois Geol. Surv. Reports, plate [illegible], figs. 4 and 4*a*, but I have concluded to place it under the above named genus in preference. The geological horizon of the specimen is [illegible] and that attached to it is a small cheek plate of a *Prœtus*.

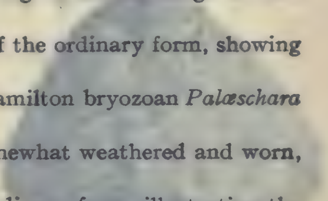
The second form mentioned is so closely similar in its external features to one figured by Mr. E. O. Ulrich in Vol. VIII of the Illinois



FOSSIL SPONGES.







EXPLANATION OF PLATE X.

Hindia indianensis, sp. nov.

Figs. 1 and 2.—Lateral and basal views of a small, quite perfect specimen, showing the prevailing form and on Fig. 2 the markings of *Roemerella grandis* Vanuxem.

Fig. 3.—Side view of a medium-sized individual of the ordinary form, showing the general structure of the surface.

Fig. 4.—View of a specimen overgrown with the Hamilton bryozoan *Palæschara reticulata* Hall.

Fig. 5.—View of the base of a large specimen, somewhat weathered and worn, showing the radiating structure.

Fig. 6.—View of a section of a specimen of the ordinary form, illustrating the highly silicified character of the entire group, chalcedonized, which has entirely destroyed all the features of the sponge, except form.

(*All figures are from photographs, nat. size.*)

FOSSIL SPONGES

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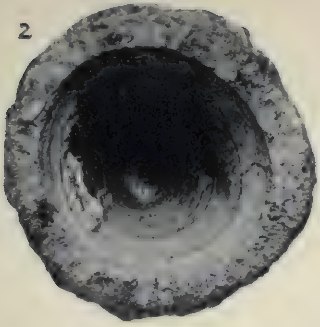

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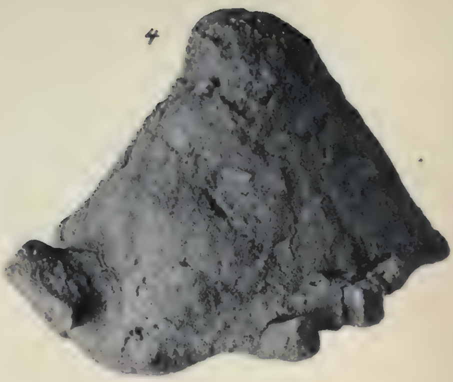

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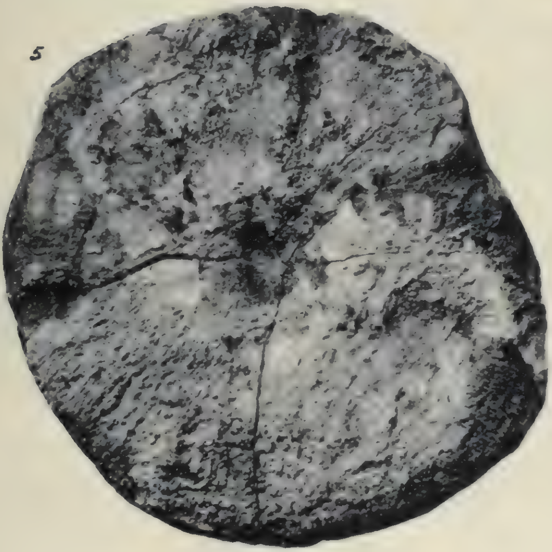

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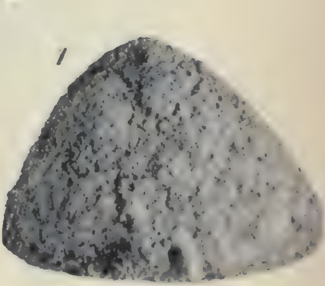

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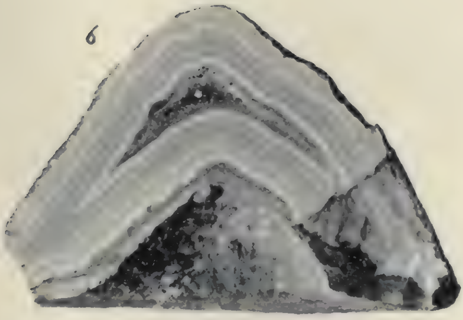

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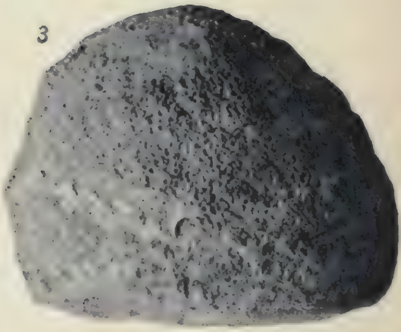

FOSSIL SPONGES.

EXPLANATION OF PLATE XI.

VERMISPONGIA HAMILTONENSIS, sp. nov.

FIGS. 1 and 2.—Views of a solid specimen, Fig. 1, showing a natural vertical section, and Fig. 2, the natural outer surface.

FIG. 3.—Top view of a flattened individual.

FIG. 4.—Natural surface of a small ovate specimen.

FIG. 5.—The under surface of a specimen, showing its starting-point to have been on a specimen of *Strophæodonta perplana* Conrad.

VERMISPONGIA DACTYLIFORMIS, sp. nov.

FIG. 6.—Side view of the only specimen of the species known.

(All figures are from photographs, nat. size.)

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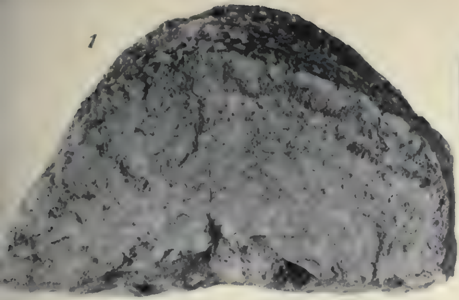

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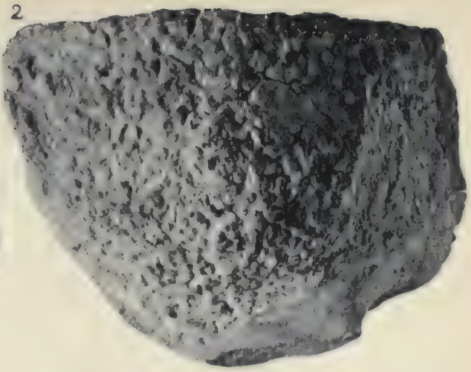

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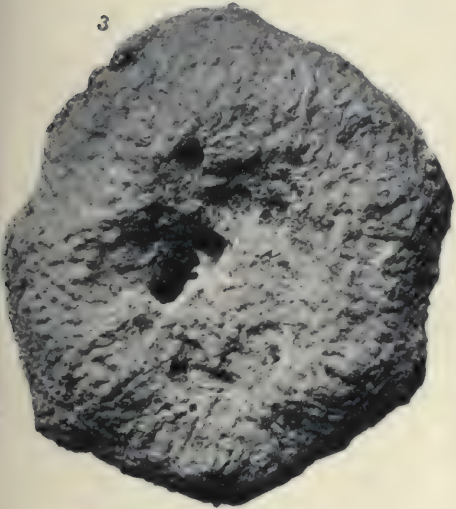

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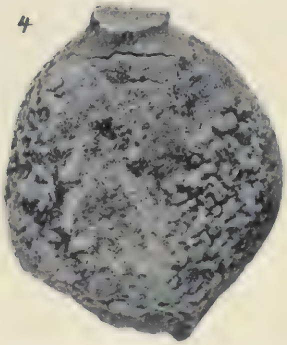

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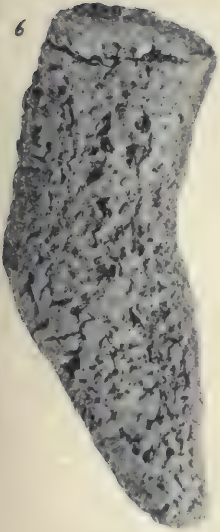

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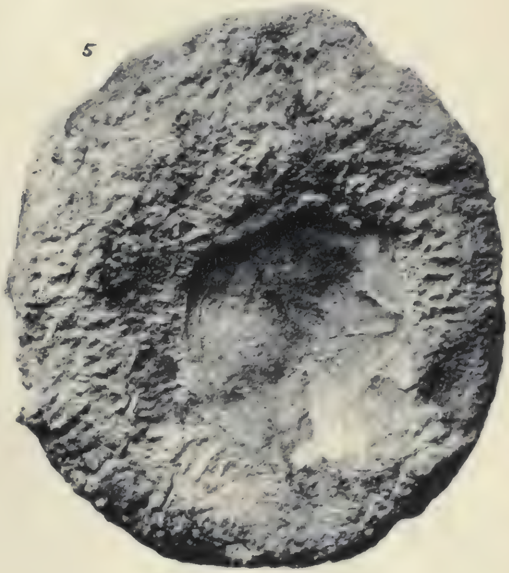

ILLUSTRATIONS OF VERMISPONGIA.

Geol. Surv., plate vii, fig. 3, under the name *Actinostroma trentonensis*, that, were it not for the difference in their geological position, I should be strongly inclined to refer our specimens to that species, but there can be no question as to their Devonian origin, as I find, besides the *Discina*-like shell above referred to, several well authenticated Hamilton Group fossils attached to the bases of the specimens, showing that the sponges grew upon them. One specimen of this form I also find nearly half covered by a growth of *Palæschara reticulata*, a bryozoan common in the Hamilton Group of New York, which throws up solid stems from the spreading base.

The resemblance of this species to an over-silicified form of *Stromatopora* or *Actinostroma* is certainly very great, but I am much more inclined to think it pertains to the genus *Hindia* Duncan, as represented in the *Astylospongia inornata* of Hall. On a large overgrown specimen, badly weathered, one can readily see indistinctly a resemblance to the peculiar structure often observed on that species. I have therefore concluded to refer this species to the genus *Hindia* Duncan, with the following description.

Hindia indianensis, sp. nov.

PLATE X, FIGS. 1–6.

Body conical, more or less elevated, often compressed and flattened. Quite generally showing an attachment in early stages of growth to a Discinoid shell (*Roemerella grandis* Vanuxem) or other foreign substance. Base always (?) concave, flattened at the margins and often rounded on the outer edge. Much weathered specimens show an incipient radial striation on the flattened border of the base, and a finely punctate structure on the upper surface, but no definite order of the punctation can be discovered. Size varying from less than one inch to fully three inches in diameter. Height very variable.

Geological formation and locality. — In the Hamilton Group at and about Speed's quarry, near Charlestown, Indiana.

The Hamilton Group fossils recognized on the bases or attached to specimens of this species are the following: *Strophæodonta demissa* Conrad, *Productella shumardana*, *Chonetes yandellana*, *Tropodoleptus carinatus*. Upon those associated with it I find *Strophæodonta perplana*, *Craniella hamiltoniæ*, *Spirifer segmenta*, and *Phacops rana* Green.

The first form mentioned at the beginning of this article, the one somewhat resembling a crushed or deformed member of the Favositidæ, I have concluded to place under the same generic head as the one mentioned as being illustrated in the Kansas Geological Report, namely, *Somphospongia*, and under the following name:

Somphospongia favositiformis, sp. nov.

Plate IX, Figs. 1–9.

Sponge body flattened, spherical, globular, or conical with a concave base, or, in some cases, almost discoid; the structure being made up apparently of a mass of compressed and laterally crushed irregular tubes, while these appear to be made up or increased by lateral expansions from the edges of the already formed tubes. The natural surfaces of the separate bodies are therefore rough, either knobby, tuberculose, or presenting the appearance of cells like those of Favosite tubes, crushed or distorted. The microscopic structure of the framework is not obtainable owing to the condition of preservation. A single specimen very highly silicified shows the arrangement of the tubes, or breathing pores, in a decidedly radiant manner, but no evidence of spicular arrangement of the skeleton can be gotten from it. The specimen is figured on Plate IX, Figs. 8 and 9.

This species is quite frequently shown to have started on *Strophœodonta perplana* Conrad, eight specimens out of fourteen present in the collection having started growth on that species of brachiopod, while one is attached to a valve of *S. concava* (?), one to *Roemerella*, one to *Spirifer segmenta*, one to *Craniella hamiltoniæ*, and one to what may have been a small *Atrya histrix* Hall.

56.4, 32F (1181:74.9)

Article XVIII.— NOTICE OF A NEW SPECIES OF FASCIOLARIA FROM THE EOCENE GREEN MARLS AT SHARK RIVER, N. J.

By R. P. Whitfield.

Some years ago I described in Monograph XVIII of the U. S. Geol. Surv. (=Vol. II, Pal. New Jersey) three species of large *Fasciolaria* from the Eocene green marls at Shark River, New Jersey, under the names *F. hercules*, *F. samsoni*, and *F. propinqua.* Now, in working over the J. J. Crooke material for incorporation with the general palæontological collection for the purpose of cataloguing, there turns up an additional species of this peculiar nodose group of the genus that is typified among recent shells by *Fasciolaria trapezoidea.* This new one differs from those described previously from this same horizon in being slightly shorter in the spire and below in proportion to the transverse diameter across the body volution; the beak also is shorter, the nodes on the whorls are quite as prominent as in *F. hercules* and count ten on the body volution as in that, but the whorls are shorter, giving a shorter spire. This species I propose to designate by naming it after the donor of the material.

Fasciolaria crookiana, sp. nov.

Figs. 1 and 2.

Shell large and massive, with the spire and beak from the middle of the body volution subequal; volutions strongly nodose on the periphery and the nodes transversely oblique, the space between the nodes and the suture sloping rapidly at a low angle; body below the line of nodes somewhat swollen in the upper third, and below this rapidly contracting to the strong, short beak or columella; columella marked by a single nearly vertical plication or fold; surface, so far as determinable, marked only by lines of growth.

Geological position and locality. — In the green marls of the Lower Eocene at Shark River, New Jersey, in the collection presented to the Museum by the late J. J. Crooke of Staten Island, N. Y.

The specimen shows evidence of the shell having been quite thick in substance, like those of its living congeners, as there are numerous casts of either worm or sponge borings in the shell substance which seem to radiate from the crest of the nodes where the shell would probably have had a greater degree of thickness than elsewhere.

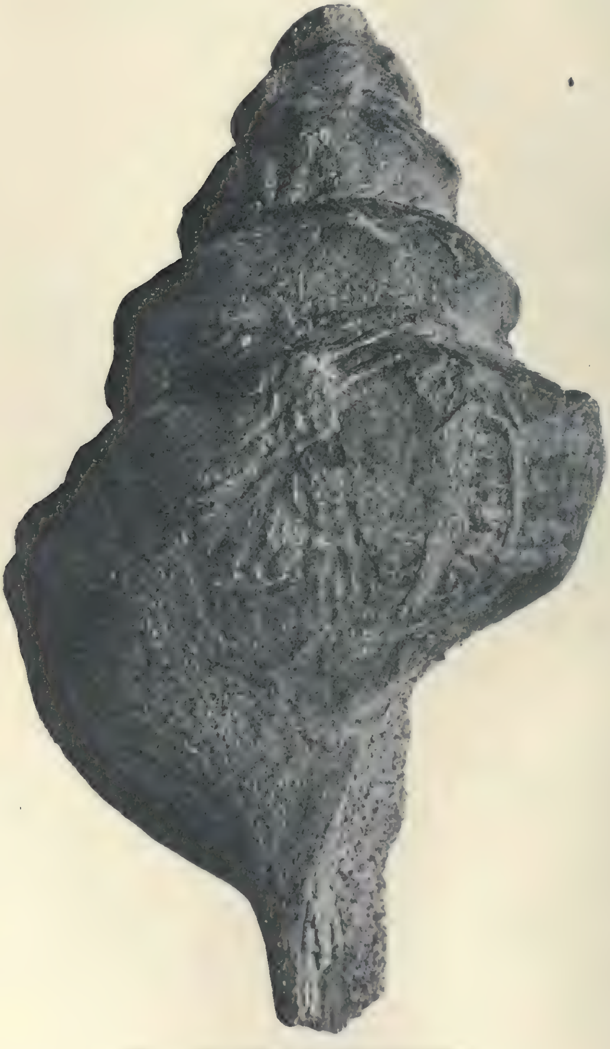

Fig. 1. *Fasciolaria crookiana*, front view.

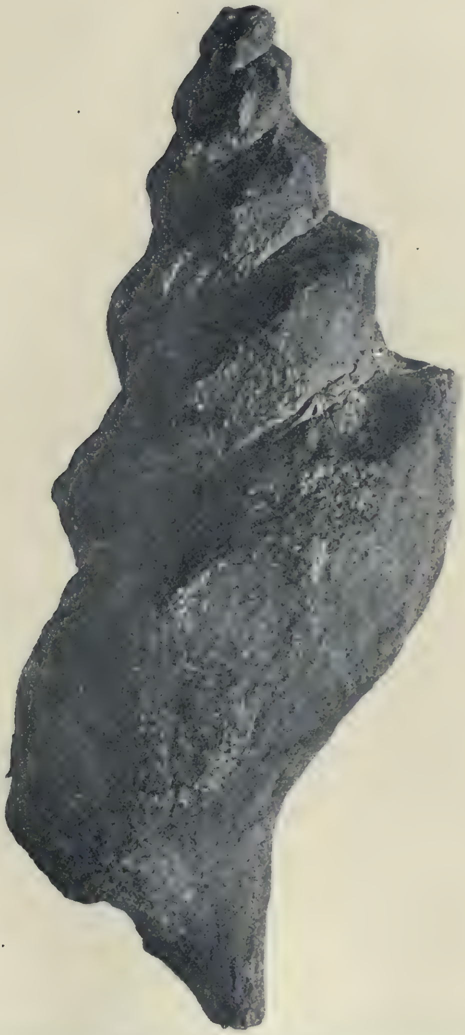

Fig. 2. *Fasciolaria crookiana*, side view, showing the amount of compression.

59.57, 96 D (7)

Article XIX. — THE NORTH AMERICAN ANTS OF THE GENUS DOLICHODERUS.

By William Morton Wheeler.

Plates XII and XIII.

Four species of the mainly tropicopolitan genus *Dolichoderus* have been recorded from America north of Mexico and the West Indies, namely: *D. mariæ* Forel, *taschenbergi* Mayr, *plagiatus* Mayr, and *pustulatus* Mayr. When in 1886 the latter author published a comparative description of all of these forms, he called attention to their close affinity with the single European and Siberian species, *D. quadripunctatus* L., and to their still closer relationship with one another.[1] Mayr even maintained that the four forms might be regarded as varieties of a single species, but owing to the absence of annectent variations he preferred to let them stand as separate species. They were based on worker specimens, though he briefly described the females of *mariæ* and *pustulatus*.

That during the past twenty years our meagre knowledge of these interesting ants has remained *in statu quo*, must be largely, if not exclusively, due to their scarcity or extremely local distribution. Having recently found two of the species, *D. mariæ* and a variety of *taschenbergi*, rather common in the pine-barrens about Lakehurst, New Jersey, I decided to study the peculiarly North American *Dolichoderi* in my collection and to publish a revision of the species, together with some notes on their hitherto unknown habits. As a result of this study, I cannot say that I am prepared to merge all four so-called species into one, but nevertheless I feel certain that *pustulatus* is merely a subspecies of *plagiatus*. The only differences I can detect between these two forms are in size, sculpture, and coloration. Among my specimens there are individuals representing a distinct variety or subspecies of each of the four Mayrian species, and showing that these, like most of our North American ants, are decidedly variable. I am able to add descriptions of the male of *mariæ* and of the male and female of the typical *plagiatus*.

It is a singular fact that the *Dolichoderi* of America north of Mexico and the West Indies are all confined to the humid eastern portion of the continent At any rate none of the species is known to inhabit the arid Southwestern and Pacific States. I have searched diligently but in vain for these ants in Texas, New Mexico, Arizona, and Colorado. In these regions *Dolichoderus* is represented taxonomically as well as ethologically by another genus of the same subfamily, *Liometopum*. *D. plagiatus* is almost subboreal in its distribution. It is found as far north as Canada (*teste* Abbé Provancher) and when occurring further south prefers sunny glades on hills or mountains. *D. mariæ* is known to occur as far north as Connecticut (Emery), but both this species and *taschenbergi* are properly members of the Carolinian zone.

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[1] Die Formiciden der Vereinigten Staaten von Nordamerika. Verhandl. k. k. zool. bot. Gesell. Wien, XXXVI, 1886, p. 434.

Descriptions of North American Dolichoderi.

The workers of our different *Dolichoderi* may be identified with the aid of the following table:

1. Head and thorax with shallow foveolæ, shining........................ 2
Head and thorax coarsely and deeply foveolate, subopaque............ 4
2. Epinotal concavity with a strong median longitudinal ridge; head, thorax, and petiole yellowish red........................... 3
Epinotal concavity without such a ridge; at least the head black...... 5
3. Body hairless above.................................*D. mariæ* Forel
At least the upper surface of head and thorax with erect hairs......*mariæ davisi* subsp. nov.
4. Base of gaster with reddish-yellow spots.................*plagiatus* Mayr
Gaster entirely black...................*plagiatus* var. *inornatus* var. nov.
5. Without erect hairs on the upper surface; body and legs deep black or very dark brown.. 6
With erect hairs on the upper surface; thorax reddish brown............7
6. Body black or brown-black, legs dark brown............*taschenbergi* Mayr
Body and appendages deep black.......*taschenbergi* var. *gagates* var. nov.
7. Base of gaster with reddish yellow spots.........*plagiatus pustulatus* Mayr
Gaster entirely black..............*pustulatus* var. *beutenmuelleri* Wheeler

Dolichoderus mariæ *Forel.*

Dolichoderus mariæ Forel, Bull. Soc. Vaud. Sc. Nat., XX, pp. 34, 35. ☿
Dolichoderus mariæ Mayr, Verhandl. k. k. zool. bot. Gesell. Wien, XXXVI, 1886, pp. 436, 437. ☿ ♀
Dolichoderus mariæ Dalla Torre, Catalog. Hymenop., VII, 1893, p. 159.
Dolichoderus mariæ Emery, Zool. Jahrb. Abth. f. System., VIII, 1894, p. 330.
Dolichoderus mariæ Emery, 27th Ann. Rep. State Board Agr. New Jersey (1899), 1900, p. 540.
Dolichoderus mariæ Wheeler, Bull. Am. Mus. Nat. Hist., XX, 1904, p. 304.

Worker (Fig. A).—Length 3.5–4.5 mm.

Head subelliptical, sides evenly rounded; occipital border rather straight; eyes placed a little in front of the middle. Clypeus flat, its anterior border

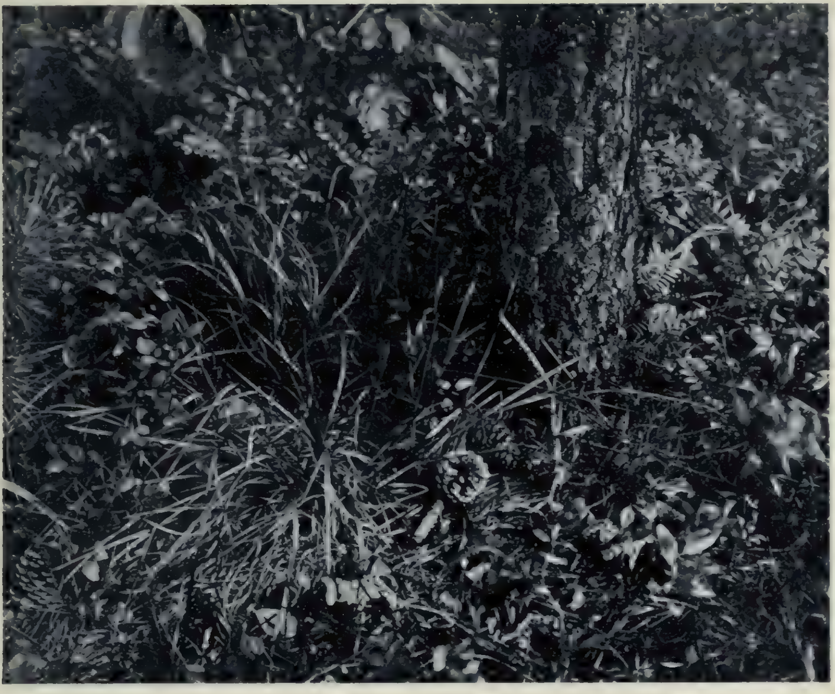


FIG. 1.

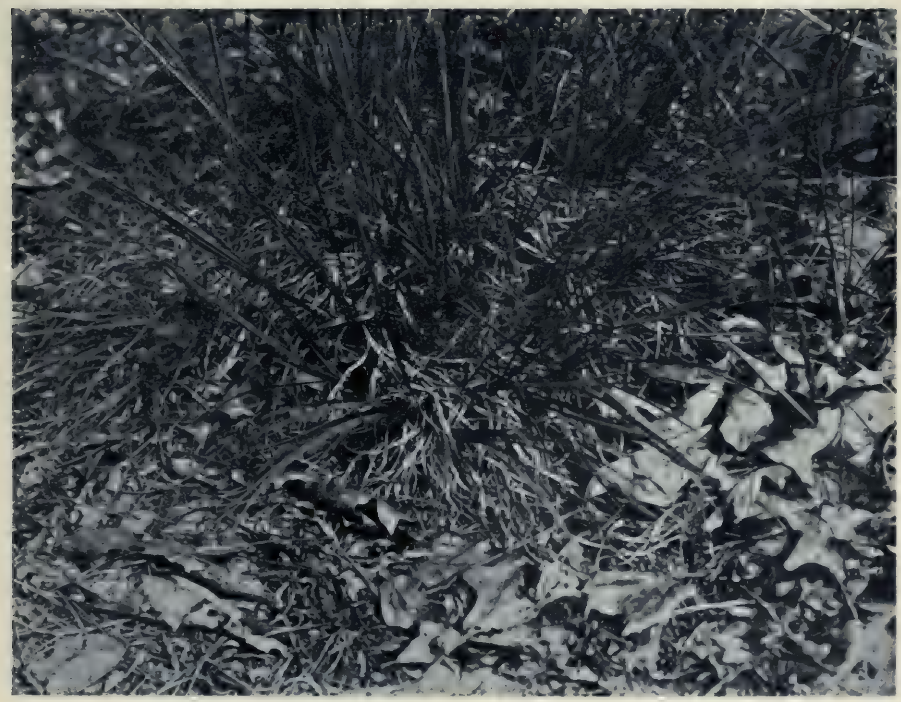


FIG. 2.

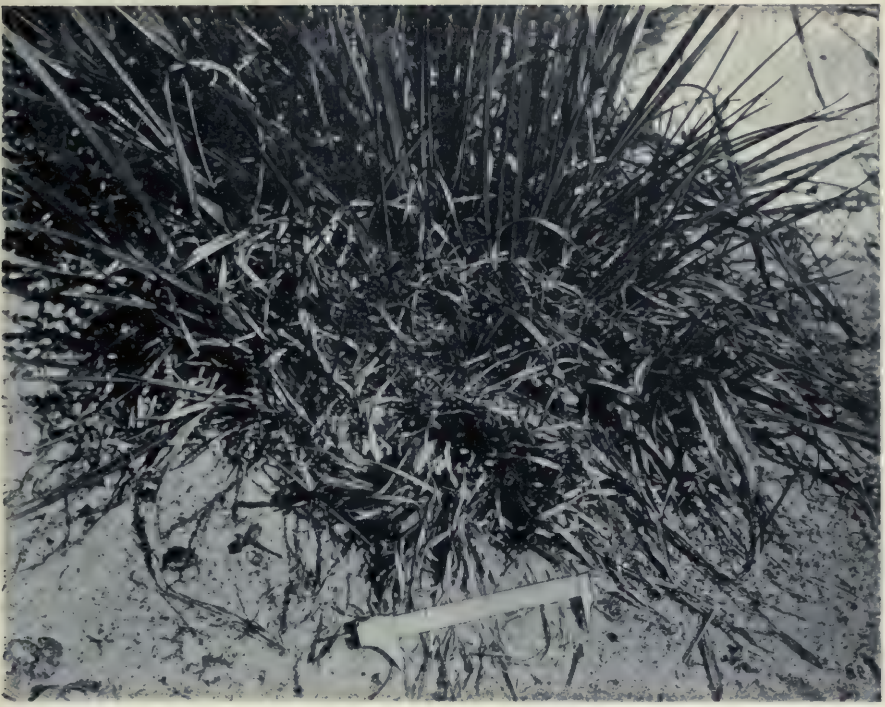


FIG. 1.

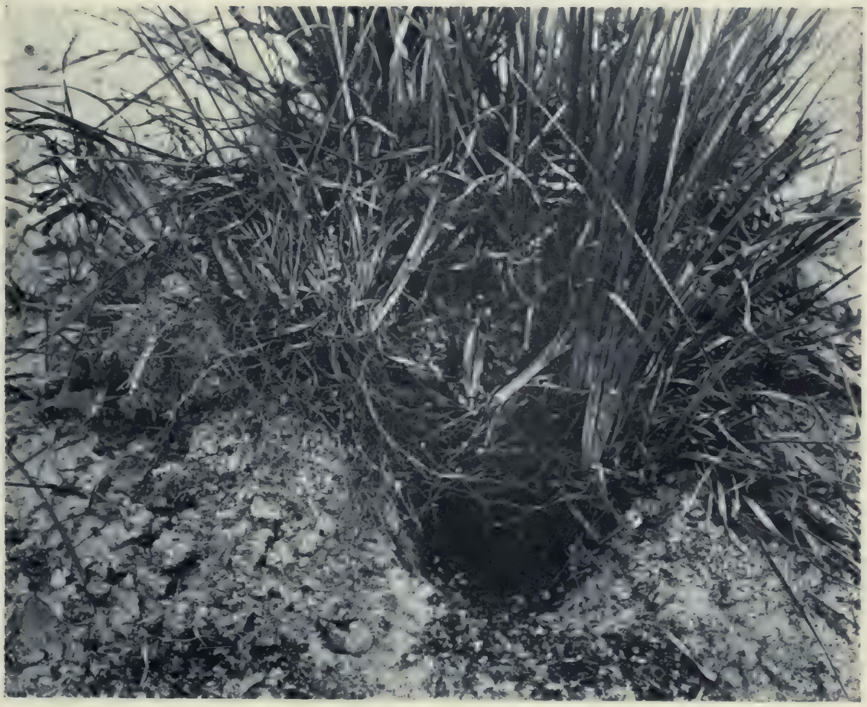


FIG. 2.

distinctly emarginate and impressed in the middle. Antennal scape curved at the base, its tip extending a distance equal to its own diameter beyond the posterior corner of the head. Funicular joints all distinctly longer than broad; two basal longer than the succeeding joints; first joint nearly 1½ times as long as the second; terminal joint somewhat longer than the two preceding joints taken together. Thorax in profile with rounded promesonotal surfaces, the former somewhat flattened behind; mesoëpinotal constriction deep. Epinotum with convex basal surface, slightly flattened in the middle, nearly as long as the mesonotum and suddenly passing by a sharp edge into the very concave declivity. Seen from above the prothorax is robust; the meso- and epinotum much narrower and laterally compressed. The sharp margin between the two epinotal surfaces is broadly rounded when seen from above and extends downward on either side to the metasternal region. There is a distinct median keel on the epinotal concavity. Petiole robust, as broad as the epinotum, but not as high as the margin between the two epinotal surfaces, with shorter and more convex anterior, and longer and flatter posterior surface; dorsal margin of node blunt and, when seen from behind, straight and transverse. Gaster broad, somewhat flattened above, first segment with a straight anterior border; constriction between the first and second segments somewhat deeper than between the succeeding segments.

Whole body smooth and shining. Mandibles with a few widely scattered, coarse punctures. Clypeus with very fine longitudinal striæ. Head, thorax, and petiole finely reticulate, with shallow foveolæ, most distinct on the posterior portion of the head and on the meso- and epinotum, but especially on the last. Epinotal concavity shining, longitudinally striated. Gaster and legs very finely reticulate, more glabrous than the other portions of the body except the mandibles.

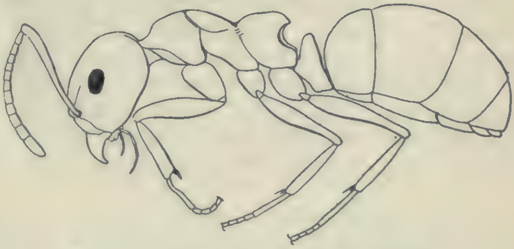


Fig. A. *Dolichoderus mariæ* Forel. Worker.

Body naked, except for a few yellowish hairs on the clypeus, mandibles, lower surface and tip of gaster, coxæ, and flexor surfaces of the femora. Pubescence pale, very sparse and indistinct except on the gaster, cheeks, and antennal funiculi.

Yellowish blood-red, terminal half of antennal funiculi black. Gaster black, with the anterior half of the first and a rather square blotch on either side of the second segment near its anterior border, yellow.

Female.—Length 4–4.5 mm.

Differs from the worker in the following characters: Clypeus convex, with a very distinct median notch. Eyes larger, ocelli present. Epinotum with convex, evenly rounded basal surface, passing into the concave surface through a rounded angle; both surfaces of equal length. Head, thorax, and petiole much smoother, quite as glabrous as the gaster. Epinotum above with shallow foveolæ, finely rugulose on the sides. Pilosity like that of the worker except that the hairs are longer on the venter. Color like that of the worker except that the head, thorax, and petiole, and the spots on the gaster are more yellow even in fully mature specimens. Each ocellus with a small brown spot. Mesonotum and posterior edge of scutellum dark brown. Wings colorless, with colorless veins and very pale yellow stigma.

Male.—Length 5–5.5 mm.

Head, including the eyes, broader than long; posterior portion evenly rounded, cheeks short, converging in front. Mandibles well developed, with denticulate blades, overlapping each other. Clypeus somewhat flattened, its anterior border without a median notch. Eyes and ocelli large and prominent. Antennæ long, all the joints longer than broad; scape rather short, as long as the first and second funicular joints together; first about half as long as the succeeding joints, which are cylindrical and subequal. Thorax robust, through the wing insertions as broad as the head through the eyes. Epinotum convex, its basal surface passing into the declivity through a broadly rounded angle. Petiole erect, low, very thick and blunt above; in profile with flat and sloping anterior and convex posterior surface. Seen from behind the upper border is straight or slightly impressed in the middle. Gaster like that of the worker but more slender and without the distinct constriction between the first and second segments. Genitalia small and embedded. Legs slender.

Mandibles smooth and shining, very sparsely and coarsely punctate. Clypeus concentrically striated, smooth in the middle. Head subopaque, densely reticulate-punctate. Thorax more shining and finely reticulate and gaster glabrous and still more delicately reticulate. Sides of scutellum sharply striated.

Pilosity and pubescence similar to those of the worker.

Deep black; tarsi and mouth-parts brown; mandibles, outer corners of clypeus, first funicular joint, wing-insertions, trochanters, and inner genital valves, honey yellow. Wings like those of the female.

The types of this beautiful species are from Vineland, New Jersey. They are in the collection of Professor A. Forel. I have seen workers from the District of Columbia, Black Mountains, North Carolina, and Manumuskin and Clementon, New Jersey, and all three phases from Lakehurst in the same State. The species has been recorded also from Virginia (Mayr) and Connecticut (Emery).

Dolichoderus mariæ davisi subsp. nov.

Worker.—Differs from the worker of the typical *mariæ* in its somewhat smaller size (2.75–3.5 mm.) and in the following characters: The basal surface of the epinotum has its greatest convexity behind the middle instead of at or very near the middle as in the typical *mariæ*. The antero-median surface of the petiole is more impressed and the edge is sharper. The sculpture of the head and thorax is more pronounced, so that these parts appear to be subopaque. The red portions of the body are duller and somewhat brownish. The most striking character, however, is the abundant pilosity. The whole surface of the body and legs, except the epinotum and dorsalmost portion of the gaster, is covered with erect or suberect whitish hairs. These hairs are most numerous on the upper and lower surfaces of the head, and on the pro- and mesonotum. On the antennal scapes they are rather long but not erect. The pubescence is hardly more abundant than in the typical form. Only the base of the first gastric segment is yellow and the lateral spots on the second segment are barely indicated.

Described from seven workers collected July 2, 1905, at Jamesburg, New Jersey, by Mr. Wm. T. Davis, to whom I take pleasure in dedicating this interesting subspecies. A dozen workers labeled "New Jersey" and received some years ago from the late P. J. Schmitt, O.S.B., are indistinguishable from the preceding. *D. davisi* exhibits such a blending of the characters of the typical *mariæ* and *plagiatus* that one is tempted to regard it as a hybrid form. More probably, however, it represents a persisting phylogenetic stage in the development of the typical *mariæ* from a *plagiatus*-like ancestor.

Dolichoderus taschenbergi *Mayr.*

Hypoclinea taschenbergi MAYR, Sitz. B. k. Akad Wiss. Wien, LIII, 1866, p. 498. ☿.
Hypoclinea taschenbergi MAYR, Verhandl. k. k. zool. bot. Gesell. Wien, XX, 1870, p. 958. ☿.
Dolichoderus taschenbergi MAYR, Verhandl. k. k. zool. bot. Gesell. Wien, XXXVI, 1886, pp. 436, 437. ☿.
Dolichoderus taschenbergi DALLA TORRE, Catalog. Hymenopt., VII, 1893, pp. 161, 162.
Dolichoderus taschenbergi EMERY, Zool. Jahrb. Abth. f. System., VIII, 1894, p. 330.
Dolchoderus taschenbergi WHEELER, Bull. Am. Mus. Nat. Hist., XX, 1904, p. 304.

Worker (Fig. B).—Length 3.5–4.3 mm.

Head a little longer than broad, elliptical; eyes in the middle of its sides. Clypeus flattened in front, convex behind, with a straight, entire anterior border, slightly impressed in the middle. Antennal scape curved at the base, its tip extending a distance equal to its own diameter beyond the posterior corner of the head. Funicular joints all longer than broad; first 1½ times as long as the second joint, second 1½ times as long as the third; terminal joint a little longer than the two penultimate joints together. Pro- and mesonotum evenly rounded, somewhat depressed, mesoëpinotal impression pronounced; basal epinotal surface rather faintly convex, somewhat flattened in the middle, passing over abruptly by means of a very sharp margin into the concave declivity. The margin is slightly convex when seen from above and passes down on either side to the metasternum. Petiole low and thick, not as high as the sharp epinotal margin, with a shorter and more convex anterior, and a longer, flatter posterior surface. Border rather sharp in profile; seen from behind it is straight and transverse or slightly impressed in the middle. Gaster broad, somewhat flattened above, with straight anterior border and a somewhat deeper constriction between the first and second than between the succeeding segments.

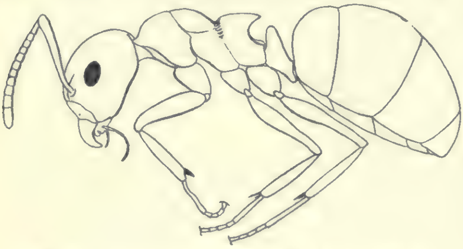


Fig. B. *Dolichoderus taschenbergi* Mayr. Worker.

Sculpture like that of *D. mariæ*, except that the foveolæ on the meso- and epinotum are somewhat more pronounced. In the mesoëpinotal constriction there are a number of regular longitudinal ridges separated by shining depressions. Epinotal concavity without a pronounced median carina, although the surface is longitudinally striated. Meso- and epinotum opaque or subopaque, pronotum and head shining, gaster very glabrous.

Pilosity and pubescence as in the typical *mariæ*.

Brownish black, antennæ, edges of mandibles, and legs dark brown.

Types from Louisiana. The species occurs also in Missouri as Emery has shown. The above description is drawn from a single specimen from the latter State in my collection.

Dolichoderus taschenbergi *Mayr* var. **gagates** var. nov.

Worker. — Differs from the typical form in being deep jet black throughout, with the exception of the edges of the mandibles and the strigils of the fore tibiæ, which are yellowish, and the neck of the pronotum which is brownish. The sculpturing of the head and pronotum seems to be less pronounced than in the typical form, so that these parts are smoother and more shining. The gaster is very glabrous.

Described from numerous workers collected at Lakehurst, New Jersey. The same form occurs at Iona (Erich Daecke), Clementon (H. L. Viereck), and Jamesburg (Wm. T. Davis) in the same State.

Dolichoderus plagiatus *Mayr*.

Hypoclinea plagiata Mayr, Verhandl. k. k. zool. bot. Gesell. Wien, XX, 1870, p. 960. ☿

Dolichoderus plagiatus Mayr, Verhandl. k. k. zool. bot. Gesell. Wien, XXXVI, 1886, p. 436. ☿

Dolichoderus borealis Provancher, Natural. Canad., V, 18, 1888, p. 408. ☿

Dolichoderus plagiatus Dalla Torre, Catalog. Hymenopt., VII, 1893, p. 160.

Dolichoderus plagiatus Emery, Zool. Jahrb. Abth. f. Syst. VIII, 1894. p. 330.

Dolichoderus plagiatus Ashmead, 27th Rep. State Board of Agr. New Jersey (1899), 1900, p. 540.

Worker (Fig. C). — Length, 3–3.5 mm.

Head elliptical; eyes rather large, in front of its middle. Clypeus convex, its anterior border notched and impressed in the middle. Antennal scape curved at the base; tip extending to a distance equal to its diameter beyond the posterior corner of the head. First funicular joint equal to the two succeeding subequal joints together; joints 4–10 nearly as broad as long; terminal a little longer than the two preceding joints taken together. Pro- and mesonotum flattened above, but slightly rounded; mesoëpinotal constriction pronounced; basal surface of epinotum in profile higher than the mesonotum, higher behind, somewhat flattened or even impressed near the middle, terminating behind in a sharp margin, below which lies the concave declivity. Seen from above the margin is broadly rounded and passes down on either side to the metasternum. The declivity in profile is not an arc of a circle, as in *mariæ* and *taschenbergi*, but has a straight or even convex outline above. Petiole thick, with a shorter and more convex anterior, and a longer, somewhat flattened posterior surface; dorsal border in profile rather sharp, seen from behind, straight and transverse. Gaster rather small, flattened, oval when seen from above, with rounded anterior border. There is a very faint constriction between the first and second segments.

Mandibles glossy, with fine longitudinal striæ and coarse punctures. Head and thorax subopaque. Clypeus and front covered with rather sharp longitudinal rugæ. Remainder of head and thorax densely punctate-foveolate, the foveolæ being so close together on the meso- and epinotum that their surfaces may be described as coarsely reticulate-rugose. Epinotal concavity, petiole, gaster, and legs smooth and shining, very finely shagreened; summit of petiole somewhat opaque and rugose.

Hairs whitish, erect, rather sparse but conspicuous on the mandibles, antennal scapes, upper surface of head and thorax, but less abundant on the gaster and very short and inconspicuous on the legs. Pubescence very sparse and barely visible, except on the gaster and antennæ.

Mandibles black, with reddish internal edges. Head, palpi, and antennæ black; scape and first funicular joint reddish yellow. Thorax and petiole dark red; meso- and epinotum and border of petiole sometimes black. Gaster black, with much of the base of the first segment and a large spot on either side of the second segment reddish yellow. In specimens from some colonies the first and second segments are reddish yellow throughout, or with only a dark median cloud on the second segment. Legs reddish yellow.

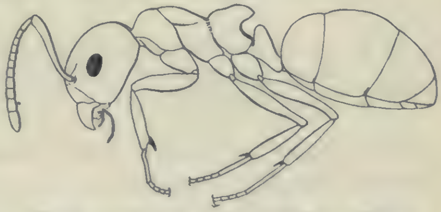


Fig. C. *Dolichoderus plagiatus* Mayr. Worker.

Female (deälated). — Length, 4–4.25 mm.

Head very similar to that of the worker. Thorax nearly as broad as the head, with the epinotum shaped like that of the worker, except that the convex basal surface is not so high as the mesonotum and does not slope upward from before backward. Seen from above the sharp margin between the basal surface and concavity is straight and very feebly excised or sinuate in the middle. The foveolæ on the head and thorax are pronounced; they are smaller and somewhat more scattered on the pro- and mesonotum and still more so on the scutellum, and somewhat elongated on the mesonotum; but much larger and almost confluent on the basal surface of the epinotum. Pro- and metapleuræ longitudinally rugose, mesopleuræ very finely punctate-rugulose. Posterior petiolar surface finely and transversely rugose. In one specimen the two basal segments of the gaster are yellow throughout, with a faint fuscous cloud in the middle of the second segment; in another specimen the gastric markings are like those of the worker. Pilosity like that of the worker.

Male. — Length, 4 mm.

Head, including the eyes, broader than long, broadly rounded behind, with prominent ocelli; cheeks short, converging anteriorly. Mandibles well developed. Clypeus with straight anterior border, entire in the middle. Antennæ rather long; scape hardly as long as the two first funicular joints, first joint about half as long as the second, which is distinctly longer than the succeeding joints; joints 3–11 subequal, cylindrical; terminal a little longer than the penultimate joint. Thorax barely as broad as the head through the eyes. Epinotum in profile with somewhat flattened basal and declivous surfaces meeting at a rounded obtuse angle. Petiole decidedly longer than wide or high, blunt above, with a short convex anterior and a long, flat, posterior surface; seen from behind, the upper border is rounded. Gaster elongate-elliptical, more slender than in the worker. External genitalia rounded and lappet-like. Legs long and robust.

Head and thorax subopaque, finely reticulate. Mandibles finely striated. Clypeus and front rather indistinctly punctate-rugulose; posterior portion of head, pro- and mesothorax sparsely foveolate. Pleuræ, scutellum, and epinotum granular. Petiole, gaster, and legs smooth and shining.

Pilosity like that of the worker. Pubescence finer and denser on the gaster and legs.

Head and thorax black, mandibles, antennæ, legs, petiole, and gaster dark brown. Wings whitish hyaline, with yellow veins and stigma, the latter with a dark brown posterior border.

The types of this species are from "Illinois" and are preserved in the Museum of Stockholm.

The above description is drawn from a number of workers collected near Rockford, Illinois, two females, one taken on Staten Island by Mr. Wm. T. Davis and the other at Lakehurst, New Jersey, by myself, and a single male taken at Newport, Rhode Island, by Joseph Leidy (Collection of American Entomological Society). There are workers in my collection from the following localities: Arlington, Virginia; Lakehurst, New Jersey; Iona, New Jersey (Erich Daecke), and Jamesburg, New Jersey (Wm. T. Davis); summit of Torne Mountain, Ramapo, New York (Wm. T. Davis), Lehigh Gap, Pennsylvania (H. L. Viereck), and Colebrook, Connecticut. The species has also been taken in Canada by Provancher and in the District of Columbia by Pergande.

Dolichoderus plagiatus *Mayr* var. **inornatus** var. nov.

Worker. — Differs from the typical form in having the gaster entirely black, without any indications of the reddish yellow spots of the typical form.

Eight workers from Rockford, Illinois, and a single worker from Lakehurst, New Jersey.

Dolichoderus plagiatus pustulatus *Mayr.*

Dolichoderus pustulatus MAYR, Verhandl. k. k. zool. bot. Gesell. Wien, XXXVI, 1886, pp. 435, 436. ☿ ♀

Dolichoderus pustulatus DALLA TORRE, Catalog Hymenopt., VII, 1893, p. 160.

Dolichoderus pustulatus EMERY, Zool. Jahrb. Abth. f. Syst., VIII, 1894, p. 330.

Dolichoderus pustulatus ASHMEAD, 27th Rep. State Board of Agr. New Jersey (1899), 1900, p. 540.

Worker. — Length, 3–3.8 mm.

Differs from the typical *plagiatus* in its smaller size, less pronounced sculpture and more uniform coloration. Head and thorax shining, with smaller and more scattered foveolæ, except the epinotum, which is coarsely foveolate. Thorax and petiole darker, often nearly black; the spots on the gaster are smaller. There are no erect hairs on the antennal scapes.

Female. — "Length, 4.4 mm.

"Coloration like that of the worker, but the mesonotum, scutellum, and mesopleuræ are blackish brown. Pilosity and sculpture as in the worker, but mesonotum with finer, coriaceous rugosity, and shallower, more scattered foveolæ. The convex basal epinotal surface is separated from the strongly concave declivity by a very prominent transverse ridge, which is feebly emarginate in the middle." (Mayr.)

Recorded by Mayr from New Jersey, District of Columbia, and Virginia. Three workers from Dacosta, New Jersey, from the collection of the American Entomological Society, belong to this subspecies. Mayr included the following variety in his description, as is evident from his mentioning specimens without spots on the gaster.

Dolichoderus plagiatus pustulatus *Mayr* var. **beutenmuelleri** *Wheeler.*

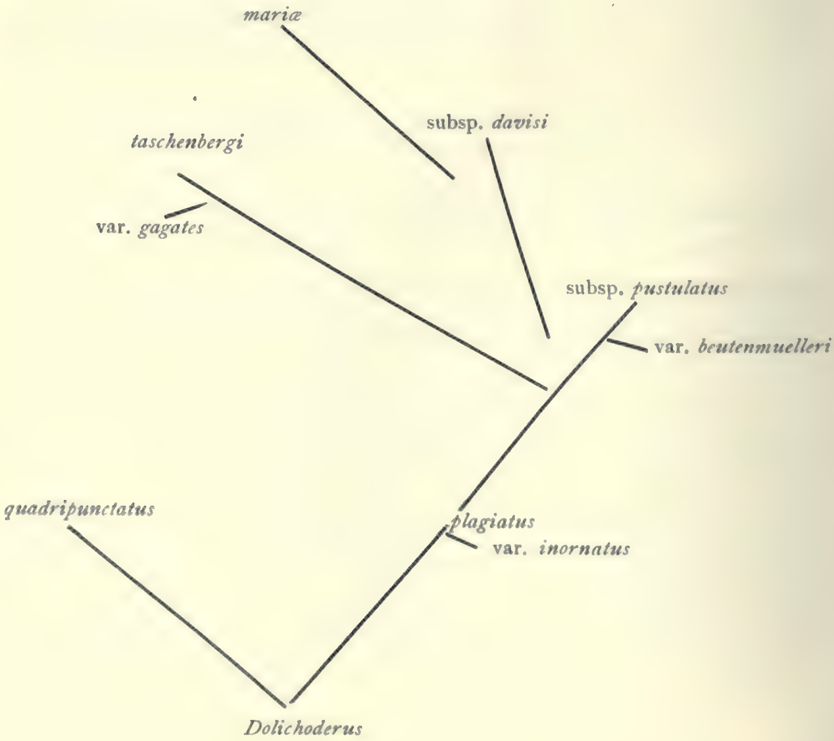
Dolichoderus plagiatus MAYR var. *beutenmuelleri* WHEELER, Bull. Am. Mus. Nat. Hist., XX, 1904, p. 304. ☿

Through a *lapsus calami* in my paper on the ants of North Carolina, this variety was attached to *plagiatus* proper instead of to its subspecies *pustulatus*. From this form it differs merely in the absence of any reddish-yellow markings on the gaster and hence in exactly the same way as the var. *inornatus* differs from the typical *plagiatus*. The antennal scapes have a few conspicuous erect hairs, especially on their flexor surfaces.

The types are from the Black Mountains of North Carolina (Wm. Beutenmüller). I have also taken several workers in various localities in the pine-barrens about Lakehurst, New Jersey. I have received from Mr. H. L. Viereck a single female belonging either to this variety or to the preceding subspecies. It was collected at Pablo Beach, Florida, April 8, by Mr. P. Laurent. As the gaster is lacking, the specimen cannot be more accurately identified.

THE RELATIONSHIPS AND HABITS OF THE NORTH AMERICAN DOLICHODERI.

A comparison of the foregoing *Dolichoderi* with one another and with the palæarctic *D. quadripunctatus* suggests a common ancestral form for both the Old and New World species. *D. plagiatus*, especially, seems to be very closely related to *quadripunctatus;* the males of the two species being, in fact, almost indistinguishable. Among the American species we can pass, on the one hand, from the highly foveolate *plagiatus* through successively smoother subspecies like *pustulatus* and *davisi* to the very smooth and brightly colored *mariæ*. The typical *taschenbergi*, on the other hand, with its extremely melanistic variety *gagates*, may also be derived from some smoother form of *plagiatus*, like *pustulatus*. These hypothetical derivations are indicated in the following diagram:


mariæ
subsp. davisi
taschenbergi
var. gagates
subsp. pustulatus
var. beutenmuelleri
quadripunctatus
plagiatus
var. inornatus
Dolichoderus

The habits of the palæarctic *D. quadripunctatus* have been studied by Latreille and Forel. Latreille's observations were embodied in a remark that the species is frequently found on old tree-trunks and that its societies are very small ("très-peu nombreuse").[1]

Forel has given a much more satisfactory account of this ant.[2] He finds that it is one of the components of a walnut-tree ant-fauna, which comprises also *Colobopsis truncata* and *Leptothorax affinis*. It nests in the wood or bark of dead branches in colonies which are rather small though much larger than the colonies of *Colobopsis*. As soon as the morning has grown sufficiently warm the workers descend the trees in files and distribute themselves over the surrounding plants where they lap up the sweet exudations from flowers, leaves, and twigs. Forel did not see them attending aphides. When disturbed they timidly crouch in the crevices of the bark. He is inclined to believe that the close superficial resemblance between the minor workers of *Colobopsis truncata* and the workers of *D. quadripunctatus* is due to mimicry. Not only are these two ants, belonging to very different genera and even subfamilies, the only European species with spotted gasters, but they closely resemble each other also in gait, stature, and behavior. Forel found as many as nine different nests of *D. quadripunctatus* in the dead branches of a single walnut tree. When workers from seven of these were placed in the same box, there were no hostilities. He concludes, therefore, that all of these nests belonged to the same colony. In other words, the colonies of this species are polydomous, but each colony contains several deälated females.

While Forel's statements go to show that the European *Dolichoderus*, like many of the tropical species, is strictly arboreal, the observations I have been able to make on our American species reveal some interesting and important differences. These observations show very clearly that our *Dolichoderi* represent at least three separate species, which are ethologically as well as taxonomically quite distinct from the palæarctic form.

The workers of *D. plagiatus* and its subspecies and varieties are occasionally found in small companies, running over the leaves of bushes and young trees in the sunny clearings of our northern woods. They lick the surfaces of the leaves wherever they are covered with honey-dew, *i. e.*, the excrement of aphides, and undoubtedly also collect the sweet substance directly from these little insects. On only one occasion have I been able to find a nest of *plagiatus*. While walking on the summit of one of the Litchfield hills near Colebrook, Conn., my attention was arrested by an unusually large number of workers (about forty) of this species clustered about some aphides on the lower surface of the leaves of a very young chestnut tree. I carefully followed the ants as they left the aphides in a straggling file and descended the tree trunk. They ran over the twigs and dead leaves and finally disappeared in a little depression in the ground about eighteen inches from the base of the tree. This depression was so well concealed under the dead leaves and twigs, that it would never have been seen without following the foraging ants. It contained between sixty and seventy workers, a number of worker larvæ and pupæ and a few callows. Many of the ants, together with the green leaves covered with aphides, were confined for a few days in an artificial nest where they could be readily seen imbibing the drops of sweet liquid from the anal openings of the plant-lice. When disturbed the ants behaved like *D. quadripunctatus;* that is, they crouched with folded antennæ in the depressions on the under sides of the leaves. Careful search failed to reveal any other colony of *D. plagiatus* in the neighborhood, and as I have never seen larger companies of these ants whenever I have found them in other localities, I feel certain that they never form large colonies. In this respect *plagiatus* resembles the European species, but though our American species still retains the ancestral habit of seeking its food on trees and bushes, it no longer nests in dead wood but in the soil.

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[1] Histoire Naturelle des Fourmis, Paris, 1802, p. 181.

[2] Fourmis de la Suisse, 1874, pp. 286–288, and Variétés Myrmécologiques, Ann. Soc. Ent. Belg., Tome XLV, 1901, pp. 380–382.

These habits are much more strikingly displayed by *D. mariæ* and *taschenbergi* var. *gagates*. As these ants are among the most beautiful and conspicuous inhabitants of that botanical and entomological paradise, the New Jersey pine-barrens, it is surprising that none of the collectors who annually visit that region has taken the pains to observe and publish an account of these insects. Both *mariæ* and *gagates* are about equally abundant and, except in a few particulars, have identical habits. The colonies are very large, comprising thousands of individuals, and strictly monodomous—that is, restricted to a single nest. The nest is excavated in the pure sand, nearly always about the roots of the broom beard-grass (*Andropogon scoparius*) (Plates XII and XIII) or of the liliaceous "turkey-beard" (*Xerophyllum setifolium*), so characteristic of the pine-barrens; more rarely about the roots of small bushes or in remnants of pine stumps. The workers remove nearly every particle of sand from the roots and dig a pot-shaped cavity from 12–18 inches in depth and 3–5 inches in diameter. (Plate XIII, Fig. 2.) The spaces between the root-fibres serve as galleries and in them the larvæ and pupæ are kept. The withdrawal of so much sand from the roots of the grass often destroys the vigor of the plant and prevents it from flowering. Bits of dead leaves, pine-needles, etc., are heaped over the surface between the grass-blades sometimes in sufficient quantity to form a flat mound, but quite as often the top of the nest is concave owing to the withdrawal of the sand and its being only partially replaced by vegetable débris. One large nest of *gagates* about ten inches in diameter was seen in the open woods surmounted by a flat mound consisting exclusively of flakes of charred pine bark which the ants had collected and placed not only on the top of the nest but between the root-fibres to a depth of a foot. On warm, sunny days, the workers bring their brood so near the surface that the maturer pupæ may be exposed to the light, while the ants themselves bask in the sun in a great mass among the bases of the grass-stems. At such times a *gagates* colony sparkles like a mass of jet beads and a colony of *mariæ* is even more beautiful, as it reflects the sunlight from thousands of bright-red and blue-black bodies.

The nests are most easily located by first finding the ants on the foliage of some one of the numerous oaks (*Quercus nana*, *obtusiloba*, *marylandica*, *prinoides*, etc.) or pines (*Pinus rigida* and *inops*) so characteristic of the barrens. A few hundred *gagates* or *mariæ* may be seen attending aphides or coccids (*Chermes*) on a branch of one of these trees and thence traced in an uninterrupted file descending the trunk and moving over the white sand, dead leaves, and pine-needles sometimes a distance of 30–50 feet to the nest. Often several files go out from the same nest in different directions to as many different trees. From the large *gagates* nest above described six files were seen radiating and traversing the barren ground for distances varying from 20 to 40 feet before they reached their respective trees.

Although these ants subsist very largely on the excrement of plant-lice and coccids, they are also very fond of insect food. A caterpillar or dead insect dropped near one of their files is soon completely covered with ants and devoured *in situ*. It is probable that the aphides and coccids within a radius that can be conveniently patrolled by a single colony are far from being sufficient to supply its thousands of workers with food. Hence the colonies must from time to time move to new localities and excavate fresh nests. That this is not infrequently done is shown by the following observations: First, several large nests which I located during September, 1904, were found to have been deserted when I revisited them during August, 1905. Second, in a particular locality the number of abandoned is much greater than the number of inhabited nests. Third, on September 16, 1905, I actually saw a large colony of *mariæ* in the act of excavating a new nest in a bunch of grass. Such changes of domicile can be readily effected on account of the simple architecture of the nest and the ease and rapidity with which the sand is excavated. Both *mariæ* and *gagates* resemble the species of *Eciton* not only in their habit of moving everywhere in files and their probably not infrequent changes of domicile, but also in the singular habit when in their nests of hanging to one another by means of their claws till they form bunches sometimes nearly as large as one's fist.

These ants resent any disturbance of their nests with all the power of their mandibles and anal glands. The secretion from the latter seems to be very volatile and does not have the rancid butter or "Tapinoma odor" of many Dolichoderinæ, like the species of *Tapinoma*, *Forelius*, *Iridomyrmex*, *Dorymyrmex*, *Liometopum*, and some of the tropical species of *Dolichoderus*, but a peculiar smoky or pungent odor, fainter in *mariæ* and stronger and of a somewhat different character in *gagates*.

It is difficult to keep these ants in artificial nests of the Fielde or Janet patterns, as they seem to be very restless and so indifferent to the sunlight that the chambers cannot be readily opened or cleaned. The original Lubbock nest, with its contrivance for permitting the ants to seek their food on an open platform, would probably be better adapted to both of the species.

The sexual phases of *mariæ* and *gagates* make their appearance at different times. I infer this from the fact that on August 19 and 20, 1905, I found the nests of *mariæ* containing male and female pupæ, many mature males, and quite a number of callow females. Single deälated and winged females were also seen running over the sand, so that August 20 is approximately the date of the nuptial flight of this species. On September 16 and 17 I again opened several nests but in only one did I find sexual forms. These were all mature, apparently belated females, and there were only worker pupæ. The nests of *gagates*, however, were searched in vain on all of these dates for males and females and their pupæ. It is certain, therefore, that the colonies of this variety throw off their winged phases earlier in the summer, probably during July and early August. In my collection there is a male *Dolichoderus* taken June 29, 1905, at Lakehurst, New

Jersey, by Mr. Wm. T. Davis. It may be the male of *gagates*, but it differs so little from the male of *mariæ* that I have refrained from describing it. I hope to obtain the males and females of *gagates* by a more timely visit to the pine-barrens during the summer of 1906.

EXPLANATION OF PLATES XII AND XIII.

PLATE XII.

FIG. 1.—Nest of *Dolichoderus taschenbergi* var. *gagates* concealed in a tuft of grass (*Andropogon scoparius*).

FIG. 2.—A similar nest of the same ant showing the accumulation of vegetable débris between the grass-blades. About ¼ natural size.

PLATE XIII.

FIG. 1.—Nest of *Dolichoderus mariæ*. About ⅓ natural size.

FIG. 2.—Nest of the same species partially opened and showing the débris accumulated in the middle and the denuded condition of the grass-roots to make room for the ants and their brood.

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Article XX.—THE NORTH AMERICAN ANTS OF THE GENUS LIOMETOPUM.

By William Morton Wheeler.

The soft, velvety ants of the remarkable Dolichoderine genus *Liometopum* Mayr appear to be confined to the south temperate portions of the northern hemisphere. So far as known, Europe, Asia, and North America each has a characteristic species. The large male of the European form, *L. microcephalum*, was described more than a century ago by Panzer[1] although the corresponding worker form was not discovered till more than fifty years later by Mayr.[2] This author was also the first to publish a brief description of the worker of our American species, *L. apiculatum*, from specimens collected in Mexico by Professor Bilimek.[3]

In 1894 Emery[4] described some Californian specimens as a new variety (*occidentale*) of the European *microcephalum*, but, as I shall endeavor to show, this form had best be regarded as a variety of *apiculatum*. More recently Forel has described a third species from Assam as *L. lindgreeni*.[5]

In addition to these three living species four fossil forms have been recorded from the Tertiary of Europe and North America: *L. antiquum* Mayr, *imhoffi* Heer, and *L. schmidti* Heer from Radoboj,[6] and *L. pingue* Scudder from White River, Utah, and Green River, Wyoming.[7] These species, however, were all described from imperfectly preserved male and female specimens more or less dubiously referable to the genus *Liometopum*.

During my myrmecological excursions into the southwestern States and Territories I have frequently met with our American *Liometopum* and have been able to learn something of its habits. Specimens of these ants from a number of localities have been accumulating in my collection till it seems to me to be possible to form a better conception of the geographical distribution of the species.

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[1] Fauna Insect. German., V, 1798, P. 54, T. 2.

[2] Beschreibung einiger neuer Ameisen. Verhand. zool. bot. Ver. Wien, Bd. II, 1852, p. 144.

[3] Neue Formiciden. Verhand. zool. bot. Gesell. Wien, XX, 1870, p. 961.

[4] Beiträge zur Kenntniss der nordamerikanischen Ameisenfauna. Zool. Jahrb. Abth. f. Syst., VIII, pp. 330, 331.

[5] Variétés Myrmécologiques. Ann. Soc. Ent. Belgique, Tome XLVI, 1902, p. 293.

[6] Vorläufige Studien uber die Radoboj-Formiciden. Jahrb. k. k. geolog. Reichsanst., 1867, XVII, pp. 57-61, Taf. I.

[7] On the First Discovered Traces of Fossil Insects in the American Tertiaries. Bull. U. S. Geol. Surv. Terr., III, 1877, p. 742; The Tertiary Insects of North America. U. S. Geol. Surv. Terr., 1890, p. 617.

Emery was under the impression that there were two species of *Liometopum* in North America, *L. apiculatum* Mayr, originally described from Mexico, and *L. microcephalum* Panz. var. *occidentale* Emery from California. Both of these forms are very closely related to the typical European species and he was undoubtedly right in considering the relationship especially close in the case of *occidentale*, since this form has the color and sometimes also the more rounded petiolar node of *microcephalum*. But an examination of a great number of workers from many colonies shows that all our American *Liometopa* agree in having a more or less pointed petiole and a very different arrangement of the dense pubescence on the gaster. Emery first called attention to the fact that this pubescence in *occidentale* is parted at the median dorsal line and diverges on either side instead of converging towards the median line, as in *microcephalum*. (Conf. Fig. 1 *a* and *d*.) The same is equally true of the typical *apiculatum*, and as both this character and the usually very pointed petiole are common to all our American forms, including a new subspecies to be described below, I do not hesitate to refer them all to Mayr's original Mexican species.

DESCRIPTIONS OF AMERICAN LIOMETOPA.

Liometopum apiculatum *Mayr*.

Liometopum apiculatum MAYR, Verhandl. k. k. zool. bot. Ges. Wien, XX, 1870, p. 961. ☿.

Liometopum apiculatum DALLA TORRE, Catalog. Hymenopt., VII, 1893, p. 163.

Liometopum apiculatum EMERY, Zool. Jahrb. Abth. f. Syst., VIII, 1894, p. 331. ♀.

Liometopum apiculatum FOREL, Biol. Centrali Amer. Insect. Hymenopt., III, 1899–1900, p. 104.

Liometopum apiculatum VIERECK, Trans. Am. Ent. Soc., XXIX, 1903, p. 71. ♀.

Worker (Fig. 1, *a* and *b*).—Length 2.5–6 mm.

Mandibles with about ten teeth on the apical and four or five very small ones on the basal border. Head cordate, as broad as long, in large workers sometimes broader than long, with broadly excised posterior border and rounded sides. Clypeus somewhat bulging at the lateral corners, with a straight anterior border. Frontal area very indistinct. Frontal groove lacking. Eyes in front of the middle of the head. Ocelli, even in the largest workers, very small and indistinct. Antennal scape curved at the base, its tip reaching to the posterior corner of the head. Funiculus but slightly thickened towards the tip; all the joints longer than broad, first and last joints longest, intermediate ones growing shorter distally. Thorax conspicuously narrower than the head, laterally compressed in the meso- and metathoracic regions; in profile rather flat above, with very distinct promesonotal and mesoëpinotal sutures; seen from above the pro-

and epinotum are of about the same length, the mesonotum somewhat shorter. Petiole produced upward into a sharp point which in some specimens may be prolonged into a soft spine; in profile inclined forward and more or less flattened or even concave both on the anterior and posterior surfaces. Gaster large, elongate elliptical, its anterior segment more or less completely concealing the petiole. Legs rather slender.

Mandibles shining, coarsely punctate towards their tips; finely and densely punctate towards their bases. Body subopaque; clypeus, head, and often also the thorax shining; finely but distinctly reticulate or coriaceous, as are also the appendages.

Body and appendages clothed with gray pubescence, so long and dense on the gaster as to hide the smooth ground surface. On the first, second, and third segments it is parted at or diverges on either side of the mid-dorsal line in such a manner as to give the gaster a shifting silky lustre somewhat like that seen on the abdomens of certain Diptera (*Sarcophaga* e. g.). Hairs gray, long, and sub-erect, especially on the head, upper surfaces of the thorax and gaster, and on the legs; short and inconspicuous on the antennal scapes.

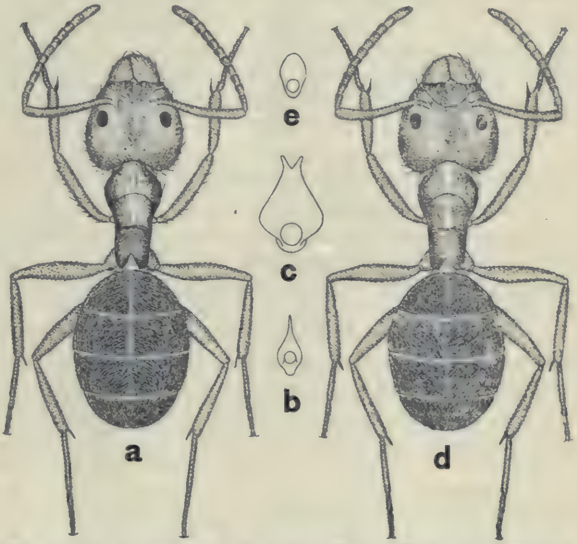

Fig. 1. *a*, *Liometopum apiculatum* Mayr. Worker; *b*, petiole of same seen from behind; *c*, petiole of female; *d*, *L. microcephalum* Panzer, Worker; *e*, petiole of same.

Body dark brown or black, with the mandibles, sides of the clypeus, cheeks, and more or less of the thorax, legs, and antennæ reddish yellow or light brown; the amount and distribution of the light color varying considerably even in workers of the same colony. Mandibular teeth black.

Female (Fig. 1, *c*).—Length 12–13 mm.

Apart from the much larger size and the usual sexual characters, the female differs from the worker in being black in color, in having darker mandibles, clypeal corners, legs, and antennæ, and in the arrangement of the gastric pubescence which is not parted and divergent but straight and uniform. The erect hairs are proportionally shorter, but denser and more abundant than in the worker. Wings long (18 mm.), brownish hyaline, with brown veins and black stigma. Petiole high and lyrate when seen from behind, with a deep notch in the summit, so that it appears to be prolonged at the apex into two slightly diverging points.

Male.—Length 9 mm.

Head very small, barely half as broad as the thorax, rounded behind, with short, flat cheeks, prominent eyes and ocelli. Mandibles and clypeus like those of the worker; antennæ long; scape but little thicker than the uniformly cylindrical funiculus; as long as the first and second funicular joints together; first funicular joint more than half as long as the second; third to last joints subequal, a little shorter than the second. Thorax very robust, broadly elliptical from above; mesonotum in profile high and arched. Petiole low and rather thick, its edge broadly rounded and notched in the middle. Gaster very short, convex above. Genital valves very large; outer pair broadly rounded above, with a short, rounded inferior lobe; median pair produced behind into a short, triangular, pointed process which has its dorsal margin broadly excised at the base and the apical margin coarsely dentate. Legs slender. Wings long (14 mm.).

Body more opaque than in the worker and female, owing to the sharper reticulation of the head and thorax.

Hairs and pubescence tawny or golden, distributed as in the female; except that the antennal scapes bristle with numerous erect hairs.

Body and appendages black, mouth-parts and inner genital valves yellowish. Wings of the same color as in the female.

Types from "Mexico," in the collection of Dr. Gustav Mayr of Vienna.

The above description is drawn from numerous workers collected by Mr. C. H. Tyler Townsend on the volcano of Colima, Mexico (7500 ft.), a deälated female from Mexico, received from Dr. Mayr, and a winged female and a single male from Arizona (Am. Mus. Nat. Hist. Coll.). Forel records the species from Pinos Altos, Chihuahua, and Ciudad in Durango, Mexico (8100 ft.). I have seen numerous workers from the following localities: Cañon City (5329 ft.) and Cotopaxi (6371 ft.), Colorado (P. J. Schmitt, O. S. B.); Manitou (6309 ft.), Garden of the Gods, and Cheyenne Cañon (7000 ft.), Colorado; Paisano Pass (5079 ft.) and Ft. Davis (5400 ft.), Texas; Las Vegas (6398 ft.) (W. M. Wheeler), Las Vegas Hot Springs (6726 ft.), and Romeroville (6303 ft.), New Mexico (T. D. A. Cockerell); High Rolls (6550 ft.), Alamogordo (4320 ft.) and Beulah (8000 ft.), New Mexico (H. Viereck). Two deälated females were taken at Manitou and one at Ft. Davis. The workers from Colorado often have the thorax rather pale, so that they approach very closely to the var. *occidentale* Emery (*vide infra*), but I believe that this name should be restricted to the Californian form.

Liometopum apiculatum *Mayr* var. **occidentale** *Emery.*

Liometopum microcephalum Panzer var. *occidentale* Emery, Zool. Jahrb. Abth. f. Syst., VIII, 1894, pp. 330, 331. ☿, ♂.

Worker.—Differs from the typical *apiculatum* in having the thorax and petiole of a clearer and more yellowish red color, although in many specimens the pro- and mesonotum are spotted with black or fuscous. In some individuals the node of the petiole when seen from behind is somewhat rounder and more like that of the European *microcephalum*. On the antennal scapes there are erect hairs, which are lacking in all my specimens of the typical *apiculatum*. This character will serve to distinguish *occidentale* from the similarly colored workers of *apiculatum* often seen in Colorado.

The types are from San Jacinto (1533 ft.) and Mariposa (1962 ft.), California (Collection of Professor Emery at Bologna).

My specimens were taken near Baldy Peak, San Gabriel Mountains, California (6500 ft.), by Messrs. Brewster, Joos, and Crawford, and near Claremont, California (1141 ft.), by Professor C. F. Baker.

Liometopum apiculatum luctuosum subsp. nov.

Worker.—Length 2.5–4.5 mm.

Apart from its somewhat smaller size, the worker of this subspecies differs from the typical *apiculatum* in sculpture, pilosity, and color. The body is much smoother and more shining. The pubescence is shorter even on the gaster so that the smooth surface is more apparent, and there are only a few rather short, erect hairs on the upper surface of the body and none on the legs or antennal scapes. All the specimens are black or very dark brown, with the mandibles, lateral corners of the clypeus, the mouth, and in some specimens also the funiculi or even the scapes of the antennæ dark red or yellowish red. Insertions of antennæ and articulations of legs yellowish.

The types of this well-marked form are from Cheyenne Cañon (7000 ft.) near Colorado Springs, Colorado. I have also taken it at Prescott, Arizona (5320 ft.), in the Coconino forest on the rim of the Grand Cañon of the Colorado (6865–7050 ft.), and down the Bright Angel Trail to an altitude of about 4000 feet. A number of workers were also collected by Messrs. Brewster, Joos, and Crawford near Baldy Peak in the San Gabriel Mountains, California (6500 ft.).

THE HABITS OF LIOMETOPUM.

L. apiculatum is structurally so closely related to the European *microcephalum* that we should expect to find a similar close resemblance in habits. Generally speaking, this proves to be the case. There are, however, a number of rather important ethological differences, which leave no doubt that the American is sufficiently distinct from the European form to be regarded as a "good" species.

The habits of *L. microcephalum*, which seems to be common in Asia Minor and southern Europe (excepting France and Spain[1]), have been studied by the leading myrmecologists, Mayr, Emery, and Forel. Mayr's account,[1] which is the earliest, may be quoted in full:

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[1] According to Er. André, Species des Hyménoptères d'Europe et d'Algerie, 1882, p. 220.

"This beautiful species probably establishes its colonies in hollow trees, since I have been unable hitherto, notwithstanding many attempts, to find its nests. It wanders about in processions ascending trees, where it could go only for the purpose of attending plant-lice. During the past three years I have repeatedly visited a couple of silver poplars standing close together and have always found this ant moving in a procession from one tree to the other, but I have been unable to discover either the nests or the winged sexes. The processions are often very long and are permanently maintained throughout the whole summer, since the workers go back and forth. Such a procession is to be seen, for example, in the Prater in Vienna, extending between four trees and measuring 180 feet in length. This procession also sends out to one side another which measures 72 feet in length and leads to two other trees."

Emery gives a more extensive account of this ant which he found to be common in Italy where it is associated almost exclusively with oak trees.[2] Between these it forms processions or files sometimes 240 feet in length. "This ant seems neither to build nor to excavate its nests, but uses the cavities and galleries dug in the wood or under the bark by the larvæ of stag-beetles (*Lucanus*), longicorns (*Cerambyx*), or other large wood-eating beetles. No other tree presents such commodious and convenient cavities of this description as the oak. . . . This ant's mode of life is largely external. It patrols great surfaces; nearly every crevice in the bark of the trees which it inhabits being used by a file of ascending and descending workers. During the hottest hours of the summer days they withdraw into their cavities, but at other times nearly all the individuals keep running about outside of the nest." Emery maintains that they do not attend aphides in order to collect their sweet ejecta, but carry these insects away as food. "*Liometopum* is preëminently a predatory ant and lives almost exclusively on animal food. . . . It runs about on the bark of the trees awaiting the coming of other insects, which it seizes. It institutes veritable *battues* for larger game. . . . While on these hunting expeditions the *Liometopum* workers always rely on the same method of quickly overwhelming their prey from all sides and holding it fast. They also behave in the same manner in their conflicts with other ants." Besides the files, which connect the various nests of a *Liometopum* colony with one another, there are other very long files which radiate out in different directions. These Emery calls "predatory or hunting files." He describes the huge males and females preparing for their nuptial flight on a July evening. The wings of the females are very easily detached. These insects were never seen to take flight voluntarily and when precipitated into the air from the tip of the finger, they flew horizontally like termites and permitted themselves to drift with the wind. He believes that mating must take place on the trees during the twilight hours and that the lumbering females take flight from the highest twigs. He is also of the opinion that *Liometopum* is an ant of which the female is gradually losing the power of flight.

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[1] Formicina Austriaca. Verhandl. k. k. zool. bot. Gesell. Wien, V, 1855, p. 319.
[2] Zur Biologie der Ameisen. Biol. Centralblatt, 1891, pp. 165–180.

Forel had occasion to study *L. microcephalum* in Bulgaria[1] and was able to confirm many of Mayr's and Emery's observations: "*Liometopum*, as a rule, forms enormous colonies which often extend over several trees connected by files of ants going back and forth. In an old oak forest near Aëtos (comprising the largest and most beautiful oaks I have ever seen) I found a *Liometopum* colony which covered twelve huge nests. In order to ascertain whether the *Liometopum* on some more distant oaks were also members of this same colony, I brought workers from the two places together. Those from the more distant oaks were attacked and pulled about, not very seriously, but with sufficient vehemence to prove that they belonged to another colony. I found *Liometopum* colonies on oaks, poplars, willows, apricot trees (which are often very large in eastern Rumelia), and elms.

"The nest entrances are often found in spots on the tree-trunks where the bark is defective, or in dead branches, but also quite as frequently in very hard wood, so that it is very difficult to obtain a piece of the nest. In Sliven, nevertheless, I succeeded in sawing off and carrying home a dead branch inhabited by *Liometopum*. It certainly looks as if only the borings of beetles had been used; but the cavities are in all probability enlarged by the ants.

"*Liometopum* is a fiercely pugnacious ant and angrily attacks and bites the intruder. At the same time it emits (evidently from its anal glands) a secretion which Emery has described as intensely aromatic and very similar to that of *Tapinoma erraticum*. As soon, however, as the first odor has evaporated, another penetrating and more disagreeable odor, which recalls that of *Lasius emarginatus*, becomes perceptible. Emery has called attention to this mixture of odors. The secretion makes the fingers sticky, which proves that there is a resinous residue as in the case of *Tapinoma.*

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[1] Die Ameisenfauna Bulgariens. Verhandl. k. k. zool. bot. Gesell. Wien, 1892, pp. 305–318, Taf. V.

"Alien ants are fiercely persecuted by *Liometopum.* With the exception of *Polyergus rufescens* and *Solenopsis geminata* I have never seen a more powerful or pugnacious ant. In Tatar-Bagardjik I witnessed a spontaneous battle between a small and apparently very young *Liometopum* colony and a colony of *Lasius niger.* The former was up on the trunk of an elm, the latter down at the base and had evidently been in the habit of visiting plant-lice on the tree. The *Liometopum* colony, which had probably only recently taken up its abode in the elm, attacked the *Lasius* in serried columns, and with a show of determination, sure and rapid movements, and coöperation, succeeded in putting them to flight. The *Lasius* rallied but could not manœuvre and intercommunicate so readily. The rapidity with which the *Liometopum* communicate with one another and assemble in force for the purpose of overwhelming an enemy is truly wonderful. On such occasions a faint crackling sound is heard. Hardly any other animal dares venture up onto trees inhabited by *Liometopum.* Only long-legged ants that can get over the ground very rapidly endeavor to run the gauntlet in order to reach the plant-lice, which are heartily despised by the *Liometopum.*"

There appeared as a postscript to Forel's paper on the ants of Bulgaria a brief note by Mayr. In this he describes, and on an adjoining plate figures, a nest of *L. microcephalum* found in a hollow oak in southern Hungary: "The material used was finely comminuted, decayed wood which undoubtedly had been compacted by means of some glandular secretion to form a brown substance like papier-maché. This substance was built up into short curved trabeculæ which branched and anastomosed like the meshes of a net, or in the form of small pasteboard-like plates, variously bent and perforated with numerous openings as large as pin-holes or larger. The paper nests of *Lasius fuliginosus* differ from those of *Liometopum* mainly in that they consist exclusively of pasteboard-like plates." In commenting on this observation at the end of the paper, Forel admits that he and Emery probably saw only the peripheral portions or outskirts of the *Liometopum* nest and that the paper portions are probably situated in the very heart of the tree-trunk. In other words, it is probable that the beetle-borings described by Emery and Forel are not a part of the true nest of *L. microcephalum*, but are merely used as runways or forecourts to the true penetralia in which the ants keep and raise their brood. This casts some doubt on the statements of Emery and Forel implying that a single colony of *microcephalum* has more than one nest.

It is evident that the American *L. apiculatum* has two peculiarities not observed in the European form. First, it is more highly variable than its Old World cousin, as is shown by the existence of at least one subspecies and one variety, and second, the altitudes recorded in connection with the localities in which it has been taken, show that it is confined to mountainous regions. The typical *apiculatum* and its subspecies *luctuosum* are, in fact, known to occur only at altitudes between 4000 and 8000 feet. They seem to be most abundant at 5000–6000 feet. It is true that most of the altitudes recorded for the variety *occidentale* are much lower, but it must be remembered that these are somewhat problematical. San Jacinto, Mariposa, and Claremont, which appear on the labels of the Californian specimens, are near the San Jacinto and San Gabriel ranges and the ants may have been actually taken at higher altitudes but attributed to the nearest towns. This dependence on rather high altitudes readily accounts for the fact that *L. apiculatum* does not occur in eastern North America. In that region, as I have shown in a former paper,[1] the genus *Liometopum* is represented, both taxonomically and ethologically, by the genus *Dolichoderus*.

I have observed many colonies of the typical *apiculatum* in the Paisano Pass and at Ft. Davis, Texas, at Las Vegas, New Mexico, and in the mountains about Manitou and the Garden of the Gods. These ants, like the European species, are continually moving back and forth in files,[2] often 100–200 feet long, over and under the loose rocks, ascending and descending the trees and bushes. They run with a soft, bounding gait, which, with their velvety bodies and warm gray tints, makes them resemble a host of Lilliputian mice. When disturbed they quickly turn their gasters up or to one side, towards the intruder, and emit a secretion which has a rank rancid-butter, or "Tapinoma" odor.

In their choice of nesting sites they differ from the European form precisely as the North American *Dolichoderi* differ from their European congeners: they nest in the ground, often some distance from the trees or plants on which they seek their food. I have seen nothing to prove that a single colony of *L. apiculatum* occupies more than one nest. June 10, 1902, I happened on a huge nest of this species on the "Crouching Lion" at Ft. Davis. It was fully two feet long and a foot and a half wide, and was situated in the ground under a large flat stone. A year or two previously the stone must have rolled down a slope onto some coarse grass and twigs and the ants had built up the earth in the interstices between these vegetable remains and compacted it with some glandular secretion till it formed a huge mass of trabeculæ, much coarser and with larger openings but otherwise similar to that figured by Mayr for the European species. The nest contained thousands of workers and fully a quart of glistening white worker larvæ and pupæ. The ants attacked me with great fury and nearly suffocated me with their intense butyric acid odor. This nest was situated in an open stony region at least 200 feet from the nearest trees. Another smaller nest of similar construction was found under a stone in the Paisano Pass, near Alpine, Texas. The specimens of *apiculatum* collected by Mr. C. H. Tyler Townsend on the volcano of Colima are also from a "large nest in the ground and dead leaves under a log." That these insects habitually build in the soil is also shown by the fact that on four different occasions, twice at Ft. Davis and twice near Manitou, I came upon isolated females in the act of establishing their colonies in small cavities excavated in the soil under stones in rather open places. One of these insects had a packet of eggs, another a packet of larvæ, and a third, that had recently died, probably from hunger or exhaustion, was being devoured by a colony of a small species of *Solenopsis* allied to *S. validiuscula* Emery. These huge females, with the exception of the females of *Atta fervens* and our larger *Camponoti*, the largest and most obese of their sex among North American ants, are thus seen to establish their colonies in the same manner as the vast majority of Formicidæ.

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[1] The North American Ants of the Genus Dolichoderus. Bull. Am. Mus. Nat. Hist., XXI, 1905, pp. 305–319.

[2] In the Paisano Pass even on cold but sunny days in the latter part of December.

While collecting in Colorado during the summer of 1903, I made repeated attempts to get at the nests of *Liometopum*, which was very common in the Garden of the Gods, where it prefers the red volcanic rocks and soil just as it does in the Paisano Pass and at Ft. Davis. The files of ants were often seen disappearing under rocks, but when these were lifted in the hope of finding their nests, it was found that only a runway or perhaps a succursal nest had been uncovered. In vain rocks were removed over large surfaces, only to find the burrow at last disappearing into the ground under the roots of some great tree, immovable boulder or cliff. The fact that in these runways the ants often congregate in numbers, together with the myrmecophilous beetles mentioned below, is apt to lead the observer to believe that he has found the nest, but these cavities contain no larvæ, males, or females, and careful inspection shows that they lead off into a continuation of the runway. The cavities are, in fact, mere temporary resting places for the out- and home-bound companies of workers.

It is, perhaps, easy to account for the difference in the nesting-sites of the European and American species of *Liometopum* when we consider the great climatic differences between southern Europe and the mountainous regions of southwestern North America. The protracted periods of drought in the latter regions make the decayed wood of tree-trunks extremely undesirable abodes for moisture-loving insects like the ants. They are therefore compelled to nest in the soil and naturally seek places under stones where the moisture is longest retained.

If the observations of Emery and Forel can be accepted as final, there is also another great ethological difference between the American and European species of *Liometopum*, a difference relating to the feeding habits. Mayr was of the opinion that *L. microcephalum* could be climbing about on the trees only for the purpose of attending aphides, but Emery claims that the ants merely devour these insects and Forel speaks of their despising the plant-lice. Our American species, however, is eminently aphidicolous and coccidicolous, although, like *microcephalum*, it is always ready to feast on any caterpillars, beetles, etc., that may fall in its path. In the Paisano Pass the files of *apiculatum* were frequently seen attending the aphides on the leaves of two species of mountain oak (*Quercus emoryi* Torr. and *Q. undulata* Torr.). At Ft. Davis I found thousands of these ants in attendance on a lot of aphides that covered the flower spikes of some large yuccas. Another colony was similarly engaged on the leaves of willows and cedars. At Manitou similar observations were made. Here they were also attending snow-white Coccidæ on roots that extended across their dark runways. These ants love to collect the nectar of flowers. In the Paisano Pass a colony was busy plundering the blossoms of the cat's claw (*Acacia wrightii* Benth.). At Ft. Davis I saw unmistakable evidence of their pronounced carnivorous instincts. A file was dragging caterpillars to its nest and a mass of ants were trying to get at the soft parts of a dead specimen of one of our largest longicorn beetles (*Derobrachus geminatus* Lec.), measuring 6.5 cm. in length. These diverse observations show the close resemblance in habits between the species of *Liometopum* in the western and the species of *Dolichoderus* in the eastern states of the Union.

My observations on the dark-colored *luctuosum* are much less complete than those on the typical *apiculatum*, owing to the fact that I saw only two colonies of the subspecies in Colorado and one at Prescott, and was unable to devote much time to observing the more numerous colonies found on the rim of the Grand Cañon. *L. luctuosum* seems always to be associated with pine trees. At any rate, the colonies in Cheyenne Cañon, Colorado, and at Prescott were ascending the trunks and had their nests under the large roots of pines. *L. luctuosum*, moreover, was the only form of the species seen in the Coconino pine forest on the rim of the Grand Cañon.

Notwithstanding its restless activity and highly carnivorous instincts, *L. apiculatum* seems to tolerate quite a number of myrmecophiles. In the runways of this ant in the Paisano Pass two different Tenebrionid beetles (*Ologlyptus anastomosis* Say and *Argoporis* sp.) and a Thysanuran (*Atelura* sp.) were frequently met with. These are probably merely synœketes, or indifferently tolerated guests. Two truly myrmecophilous beetles, however, belonging to the Aleocharine Staphylinidæ, namely *Apteronina schmitti* and *Dinardilla liometopi*, both described some years ago by Wasmann,[1] are known to occur only with *L. apiculatum*. They were discovered by the late Rev. P. J. Schmitt, O. S. B., at Cotopaxi, Colorado, not in the "nest of *Liometopum*," as Wasmann states, but in the runways of these ants, as Father Schmitt once informed me. These beetles were sought in vain in the Paisano Pass and at Ft. Davis, but I had no difficulty in finding them in the Garden of the Gods and in Cheyenne Cañon near Colorado Springs. There were sometimes as many as four or five of each species under a single stone covering one of the runways. They seem to lie in wait and take toll in the form of honey-dew from the ants that are traversing the burrow on their way to the nest. According to Wasmann, "the structure of the tongue of *Apteronina* indicates that this insect is fed from the mouth of its hosts, like *Atemeles*,

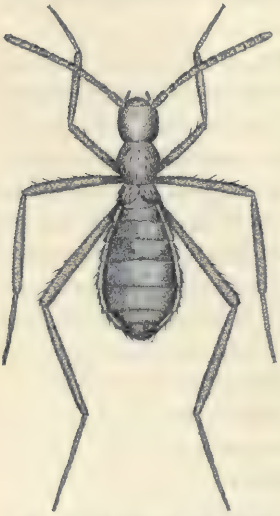

Fig. 2. *Apteronina schmitti* Wasmann.

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[1] Zwei neue *Liometopum*-Gäste aus Colorado. Wien Entomol. Zeitung, 20. Jahrg., 7. Heft 30 Sept., 1901, pp. 145–147.

Lomechusa, etc." These beetles are of more than usual interest because they are both tactual mimics, that is, they probably deceive the ants through a resemblance in form or surface texture to the *Liometopum* workers. While both beetles are highly pubescent, like these workers, they differ greatly in form; *Apteronina* being decidedly ant-like, whereas *Dinardilla* has the form of beetles which ants have considerable difficulty in seizing or holding in their mandibles. According to Wasmann, *Dinardilla* is allied to *Dinarda*, a genus comprising several interesting European myrmecophiles. *Apteronina*, according to the same authority, resembles *Apteronillus* and even more closely several *Eciton* guests of the mimetic type. Probably both of the *Liometopum* guests are in the habit of accompanying their hosts as they move along in files. In this respect the relationship of *Apteronina* with *Apteronillus* and its allies is very suggestive, since the *Eciton* guests are actually known to accompany the files of their nomadic hosts.

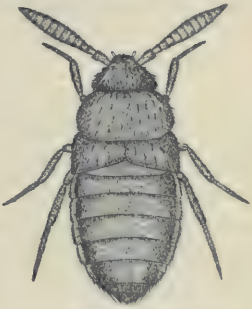

Fig. 3. *Dinardilla liometopi* Wasmann.

A study of the behavior of *Dinardilla* and *Apteronina* in artificial nests would undoubtedly yield interesting results. While I was in Colorado there were so many matters of myrmecological interest to occupy my time and attention, that I unfortunately neglected to observe these beetles under suitable conditions. I include a couple of sketches (Figs. 2 and 3) that may aid some future observer in identifying these singular creatures.

56.813 C (1181: 78.9)

Article XXI.—ON THE SKULL OF A NEW TRIONYCHID, CONCHOCHELYS ADMIRABILIS, FROM THE PUERCO BEDS OF NEW MEXICO.

By Oliver P. Hay.

The skull which is here described was collected in the year 1892 by Dr. J. L. Wortman, then in charge of a collecting party from the American Museum of Natural History. It was obtained in the Puerco beds of the northern part of New Mexico. The specimen bears the catalogue number 6090. The skull is quite complete, with the exception of the absence of the lower jaw. The specimen was enclosed in a nodule of very compact clay, the removal of which was difficult; but this has been skilfully done by Mr. Albert Thomson, of the American Museum. Figures of the object as seen from above, from below, and from the right side are here presented. These are two-thirds the size of nature. These figures are half-tones from wash-drawings prepared by Mr. Erwin W. Christman.

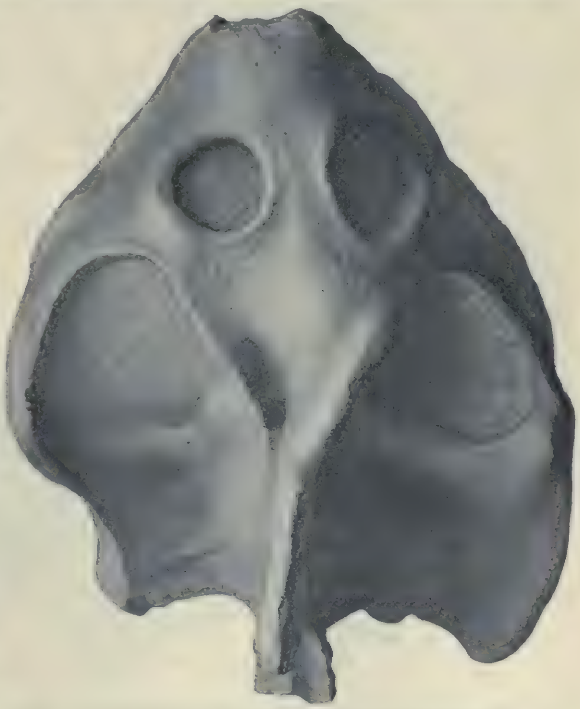

Fig. 1. *Conchochelys admirabilis.* View of skull from above. × ⅔

The skull is that of a large and evidently aged individual. No sutures whatever are to be observed, a matter greatly to be regretted in this case.

The premaxilla and the anterior extremities of the maxillæ are missing, but the portions gone would add little to the length of the snout. The distance from the front of the nasal bones to the extremity of the occipital condyle is 127 mm. The breadth across the zygomatic arches is 111 mm.; the distance from the outside of one quadrate to that of the other appears to have been about 88 mm.; and the width across the skull at the middles of the tympanic cavities is 108 mm. It will be seen therefore that the roof of the tympanic cavity projects much over the pedicles of the quadrates. Usually in living trionychids the breadth across the pedicles of the quadrates is as great, or nearly as great, as the breadth at any other part. The hinder portion of the skull is shortened. The extremity of the condyle is only 13 mm. behind the line joining the quadrates. In a specimen of *Amyda ferox* 94 mm. long from the snout to the condyle, the latter is placed at a distance of 17 mm. behind the quadrates. Relatively to other species of the group the skull is broad, the breadth being 86 per cent. of the length. In *Pelochelys cantoris*, whose skull is relatively broad, the width of the latter is 82 per cent. of the length. The skull of the species under description is flat, and this appears to be due in no measure to crushing. Placed on a level surface, the skull has its crest elevated to a height of 65 mm. The snout has been blunt. The skull maintains its breadth as far forward as the line joining the posterior borders of the orbits, where it is 98 mm.: then the outlines converge rapidly. The interorbital space is 15 mm. wide. The orbits look outward, forward, and upward. They are circular, with diameters of 22 mm. From the orbits the sides of the face slope downward and outward.

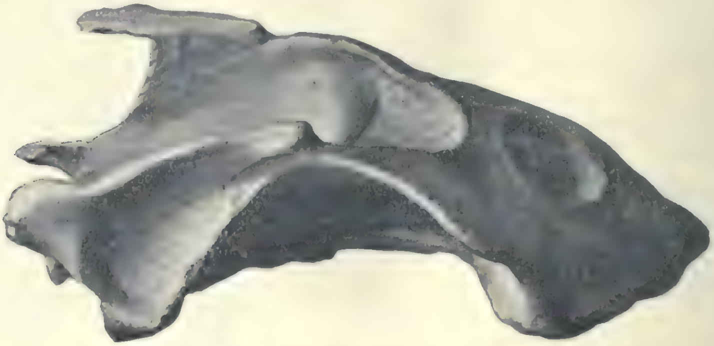

Fig. 2. *Conchochelys admirabilis.* View of skull from left side. × $\frac{2}{3}$

The anterior nasal opening appears to have had little height, rising only 8 mm. above the floor of the passage. Its breadth has been 20 mm. The lateral crests of the parietals converge rapidly and meet opposite the fronts of the proötics. The postorbital arch has a width of 11 mm. The zygomatic arch has a width of only 8 mm. in the middle of its length. At its anterior inferior border it starts from the hinder extremity of the cutting edge of the maxilla, and ascending it passes backward to the front of the tympanic cavity. It is far more arched than that of living trionychids. The tympanic cavity is relatively longer than that of *Amyda ferox*, the length being 33 mm., one-fourth the length of the skull. In *A. ferox* the length of the cavity is about one-fifth the length of the skull. In contradistinction to *A. ferox*, the upper border of the squamosal is not rolled downward, but stands out as a sharp edge. Moreover, there does not appear to have existed that long backwardly directed process of the squamosal and paroccipital which we find so conspicuous in the living trionychids. It is possible that this process was originally somewhat longer than now appears; but it could have been but little longer.

The fossa enclosed by the zygomatic arch is greatly different from that of *Amyda*. In the latter, and perhaps in all living members of the Trionychidæ, the fossa is longer than broad. In this Puerco genus the length is 34 mm., the width about 38 mm.

The occipital crest has been injured and is partly missing. It has included a lower horizontally expanded border and a thickened superior border. The latter may be, so far as preserved, the backwardly prolonged parietals.

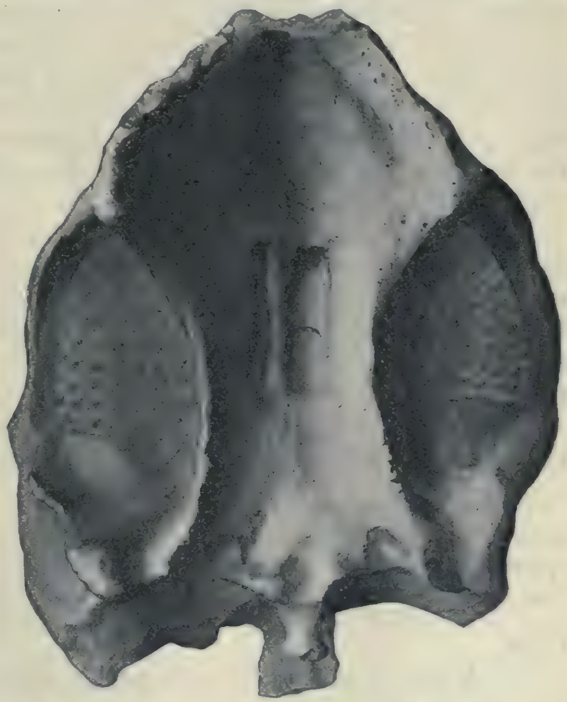

Fig. 3. *Conchochelys admirabilis.* View of skull from below. × ⅔

The upper jaws were furnished with subacute cutting edges. From these the palate rises in a high vault, 26 mm. above the cutting edges. The choanæ are removed far backward, their front borders touching a perpendicular plane through the posterior borders of the orbits. The distance from the premaxillæ to these choanæ was about 50 mm. There was, therefore, an enormous crushing surface on the upper jaws, and we may conclude with safety that the animal was accustomed to devouring a prey that was protected by hard coverings, such as mollusks. From each choana a groove in the roof of the mouth extends backward about 30 mm. This probably indicates that in life the fleshy choanæ were situated behind the middle of the length of the skull. As a result of this position of the openings there was no danger, while food was being triturated, of any interference with respiration.

The pterygoid region is greatly narrowed, being where narrowest only 36 mm., a little less than one-half of the distance between the hinder ends of the maxillæ. In the specimen of *Amyda ferox* already referred to, the pterygoid region is at least 33 mm. wide, eight-tenths the width of the upper jaws. This region in the fossil is very concave transversely. Anteriorly the borders of the pterygoids pass, on each side, into a ridge which meets the hinder end of the maxillary cutting edge. Posteriorly the border of each pterygoid extends outward to the pedicle of the quadrate. The articulation of the quadrate was about 20 mm. wide.

In its broadened form, its narrowed pterygoid region, its shortened basioccipital region, and in its apparently abbreviated posterior squamosal process, this trionychid presents such deviations from known genera that the writer is led to the conclusion that it represents a distinct and hitherto undescribed genus. This he proposes to call **Conchochelys,** in allusion to the supposed nature of its food.

Until more shall have been discovered regarding the structure of the animal the following may be taken as the generic characters:

Skull broad. Masticatory surfaces broad and concave. Pterygoid region narrow. Basioccipital region short. Choanæ behind the orbits. Posterior squamosal process apparently much shortened.

The species may be known under the name **Conchochelys admirabilis.**

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59.82 (72.3)

Article XXII.—LIST OF BIRDS COLLECTED IN SOUTHERN SINALOA, MEXICO, BY J. H. BATTY, DURING 1903–1904.

By Waldron De Witt Miller.

The collection of birds recorded in the present paper was made by Mr. J. H. Batty in southern Sinaloa, Mexico, between December 8, 1903, and November 5, 1904. The collection numbers 1164 specimens, representing 160 species. Following are the principal localities at which collecting was done, with their elevation, and the dates of collecting at each.

Escuinapa (elevation 50–100 feet), December 19, 1903, to April 11, 1904; May 23 to November 5, 1904. Arroyo de Limones (3500 feet), April 14 to 23; May 17 to 21, 1904. Los Pieles (3500 feet), April 14 to 23; May 17 to 21, 1904. Juan Lisiarraga Mountain (5500 feet), April 24 to May 16, 1904. Juanna Gomez River (50 feet), June 1 to 9, 1904.

While making his headquarters at Escuinapa, the collector covered the southern part of Sinaloa, from Mazatlan to northern Tepic. He worked east from Escuinapa, during April and May, 1904, for at least sixty miles, into the western foothills of the Sierra Madre. The minor localities near Escuinapa are Hacienda and Los Cabras Islands, Elota, Brazil, Caletie, and Cyoatlan, varying in altitude from sea-level to about 800 feet. Additional localities in the foothills are Papachal (1200 feet), Cosala (1500 feet), Lavanilla (3000 feet), Jalpa (3500 feet), and La Balla Mountain (4500 feet).

The following brief description of the country covered by the collector is gathered from his notes:

A strip of country bordering the coast and reaching nearly all the way from Mazatlan to the Territory of Tepic is covered with lagoons and rivers. It has a heavy growth of mangroves, and is sparsely interspersed with sandy knolls and flat patches of higher ground covered with other vegetation. East of the lagoons, for the five miles to Escuinapa, and to the foothills of the Sierra Madre, is a long flat plain covered mostly with thorny bushes, yuccas, and patches of high grass. On this tract are scattered occasional ranches.

Northwest of Escuinapa the country is the same for several hundred miles. The same character of country continues also southeast for seventy miles. Further south, hills appear and gradually increase in size until the high Sierra Madre is reached, a distance of about one hundred miles.

East of Escuinapa rise small bushy hills, sparsely covered with chapparal, mesquite, and other thorny bushes and trees. Twenty miles directly east, the altitude is about 3000 feet, at sixty miles 5000–6000 feet, and at the boundary line of Durango about 8000 feet.

Advancing upward from the flat country, the aspect and vegetation gradually change. At 4000 feet, oaks first appear; at 5000 or 6000 feet there are grassy hills, the valleys between being wooded, principally with large oaks. Still higher, the oaks are mostly replaced by scattered groves of large pines.

For the loan of specimens and for other assistance, I wish to express my indebtedness to Dr. Charles W. Richmond and the authorities of the United States National Museum, and to Mr. E. W. Nelson, of the Biological Survey.

All measurements of specimens are given in millimeters. Two new subspecies, *Amazona albifrons nana* and *Amizilis beryllina viola*, are described.

The remarks on distribution, habits, color of bill, feet, and soft parts, when inclosed in quotation marks, are transcribed from the collector's labels.

1. **Crypturus occidentalis** *Salvadori.* — Seven specimens, as follows: Escuinapa, 1 specimen, March 26; Los Pieles, 3 specimens, April 16; Lavanillo, 3 specimens, June 24. The June birds are molting their worn and faded body plumage. "Common. Found singly and in pairs, generally on hills or mountains, not met with on lowlands. Breeds in July; has 5 to 10 eggs; nests on the ground. Rapid flyer. Call a clear whistle. Feet and legs dark shrimp red, soles dirty brownish white. Iris grayish brown" in the April specimens (1 male, 2 females), or "grayish yellow" in the June birds (2 males, 1 female).

2. **Fregata aquila** *Linn.* — One adult female, Escuinapa, January 14. "Common. Gular sac pale bluish purple. Iris dark hazel. Feet pale magenta. Bill light horn."

3. **Spatula clypeata** (*Linn.*). — Two specimens, Escuinapa, January 26. "Rather common."

4. **Nomonyx dominicus** (*Linn.*). — One female, Escuinapa, December 28. "Iris dark hazel." This specimen measures, wing, 118 mm.; culmen, 31.6, greatest width of maxilla, 15. The last measurement indicates an unusually narrow bill, but through lack of material I am unable to determine whether this fact is of any significance.

5. **Guara alba** (*Linn.*). — Three specimens, Escuinapa, March 24–30. "Common."

6. **Cochlearius zeledoni** *Ridgw.* — Six specimens, all adult, as follows: Escuinapa, 3 specimens, May 18 and 27; Hacienda Island, 2 specimens, May 27 and 28; Juanna Gomez River, 1 specimen, June. "Iris dark hazel, nearly black. Feet and legs pale yellowish green. Gular sac and bare space about eye pale greenish yellow." The following is taken from the labels of the Hacienda and Sinaloa specimens: "Rather common; nocturnal. Breeds in pairs and colonies in June. Found about fresh and brackish water, preferring fresh water. Feeds on small fish, shrimps, etc."

7. **Nycticorax nycticorax nævius** (*Bodd.*). — One adult female. Escuinapa, May 18. "Common; breeds in May and June."

8. **Florida cærulea cærulea** (*Linn.*). — One adult male, Escuinapa, March 30.

9. **Tigrisoma cabanisi** *Heine.*—Two specimens, Escuinapa. One adult male, January 24: "Iris pale yellow. Feet greenish black. Bill, upper mandible dark horn, lower mandible greenish yellow. Gular sac pale greenish yellow." One immature female, January 5: "Iris narrow, light yellow. Feet apple green. Cere and space about eyes yellowish green, eyelids greenish yellow. Common."

10. **Porzana carolina** (*Linn.*) — One specimen, Escuinapa, September 3. "But one specimen seen to date."

11. **Fulica americana** *Gmel.* — Five specimens, Escuinapa, 2 specimens, October 27 and January 1, and 3 without dates. "Iris cherry red. Feet dirty pale green and black. Common."

12. **Recurvirostra americana** *Gmel.* — Two specimens, Escuinapa, December 22 and 23. Male: "Eye dark hazel. Legs and feet pale opal blue. Common."

13. **Himantopus mexicanus** (*Müll.*). — Two specimens, Escuinapa, November 4 and December 23. "Common. Not observed breeding."

14. **Actitis macularia** (*Linn.*). — One female, Arroyo de Limones, April 20. This specimen is undergoing an extensive molt; the plumage has been largely renewed but growing feathers are still present on the crown, interscapulum, breast, etc. The outermost primary is about two-thirds grown and the tail is nearly complete. "A few stragglers, April."

15. **Totanus melanoleucus frazari** *Brewster.* — One female, Escuinapa, December 24. This specimen satisfactorily exhibits the characters claimed by Mr. Brewster for his subspecies *frazari*. Com-

pared with the few available eastern specimens in winter plumage, the upper parts are considerably paler and grayer, and the crown is more broadly streaked with white. The streaking and speckling of the cheeks is also finer and the breast is more narrowly streaked. The measurements are as follows: Wing, 183.5 mm.; bill from nostril, 44; tarsus, 56.

16. **Jacana spinosa** (*Linn.*). — Ten specimens, only three of them adult, Escuinapa, September 3, November 5, and December 28–January 24. Adult male, December 28: "Iris hazel. Feet dark blackish green. Bill light orange; cere reddish orange; protuberance orange." Immature male, January 2: "Iris hazel. Feet dark apple green." Immature female, January 22: "Iris whitish yellow. Feet yellowish olive green; claws brownish horn. Lower mandible greenish yellow, base darker; upper mandible, point brownish yellow, base and ridge yellowish green. Cere greenish yellow." The color of the iris and feet of another specimen, an immature male, January 24, is given as similar to that of the last described. "Common. Breeds in August."

17. **Cyrtonyx montezumæ montezumæ** (*Vigors*). — Eight specimens, Juan Lisiarraga Mt., April 24–May 13. "Gregarious except in breeding season. Rather common; generally found among oaks at from 4000 to 9000 feet altitude. Hides under leaves and among loose rocks until nearly stepped on. Breeds in June. Iris hazel. Feet pale whitish lead."

18. **Lophortyx douglasi douglasi** (*Vig.*). — One hundred and twenty-nine specimens as follows: Escuinapa, 120 specimens, December 20–April 6, July 14 (one), August 5 (2 young), September 20–30, October 2–27; Arroyo de Limones, 5 specimens, April 11–18; Juanna Gomez River, 1 specimen, June 2; Cosala, 1 specimen, December 8. This series exhibits considerable variation in coloration. The shape and size of the black throat markings of the males vary greatly. The females differ much among themselves, some specimens suggesting the males in color. Many specimens, taken from December to March inclusive, show molt taking place in the primaries and at other points. "Common. Gregarious. Found on lowlands and foothills of Sierra Madre. Breeds in April and May. Lays eight to twelve eggs; nest on the ground. Sometimes has as many as twenty eggs at one sitting. Roosts in bushes and trees, and *not* on ground." "Iris hazel." Feet of male described by collector as "bluish black," "pale olive brown," "dirty greenish white," etc., according to the individual; bill usually as "brownish black."

19. **Ortalis wagleri** *Gray.* — Thirty-nine specimens: Escuinapa, 21 adults, December 23–January 16, and 1 young in down, July 3; Juanna Gomez River, 3 young in down, July 4; Los Pieles, 9 adults, May 17–21, June 18; Papachal, 1 adult, December 9; Jalpa (alt. 3500 feet), 1 adult, April 16; Arroyo de Limones, 1 adult, April 21; and 2 adults without labels. Escuinapa: "Common; steady resident. Crest carried erect and spread forward. Windpipe runs full length of sternum and back in males only. Iris hazel. Feet blackish brown. Bill dark brown, tips of mandibles lightest." The chick, dated July 3, shows three or four chestnut-rufous feathers appearing on each side of the belly, while the three taken on July 4 are wholly in the downy plumage. Los Pieles: "Common on lowlands and in foothills to 4000 feet altitude. Breeds in June; nests in high trees but sometimes in rocks on steep hillsides. Nests of sticks and leaves; has generally 3, sometimes 4, rather large roundish, whitish eggs. Feeds principally on berries and insects. Has a very loud, noisy cackle."

20. **Penelope purpurascens** *Wagler.* — Eight specimens: Escuinapa, 1 specimen, February 28; Arroyo de Limones, 7 specimens, April 1–23. Arroyo de Limones: "Iris brownish red; feet and legs magenta; gular sac brick red. Common, breeds in June. Said to build nests in high trees, of sticks and leaves, and to have 4 to 6 eggs with heavy white shells."

21. **Geotrygon montana** (*Linn.*). — One specimen, a male, Arroyo de Limones, April 21. "Eye reddish hazel. Feet pale magenta. Stragglers only seen."

22. **Scardafella inca** (*Lesson*). — Six specimens, Escuinapa, October 28, December 22–29. "Common; breeds in April and May. Iris very narrow, orange; feet and legs flesh."

23. **Columbigallina passerina pallescens** (*Baird*). — Four specimens, Escuinapa, October 14 and 31, and December 23. "Common; steady resident. Breeds."

24. **Columbigallina rufipennis eluta** *Bangs.* — Three specimens, Escuinapa, October 1–28. "Steady resident; breeds; common. Iris narrow; pale gold" or "yellowish gray."

25. **Melopeiia leucoptera** (*Linn.*). — Three specimens, Escuinapa, October 27, December 26 and 27. "Common; steady resident. Breeds." The October specimen had nearly completed the annual molt, including the wings.

26. **Leptotila fulviventris brachyptera** (*Salvad.*). — Four specimens: Escuinapa, 1 specimen, February 2; Juan Lisiarraga Mt., 2

specimens, May 3 and 4; Juanna Gomez Creek, 1 specimen, June 2. "Iris reddish orange"; in one specimen (male, June 2), "light grayish brown." "Feet and legs magenta. Bill solid brownish black. Rather common; steady resident. Arrives in April. Observed to 6000 feet altitude in Sierra Madre (west slope)."

These specimens average slightly browner above than a series from the lower Rio Grande Valley in Texas.

27. **Zenaidura macroura macroura** (*Linn.*). — One specimen, Escuinapa, November 6.

28. **Columba flavirostris flavirostris** *Wagler.* — Five specimens: Escuinapa, 4 specimens, January 24–April 8; Los Pieles, 1 specimen, April 16. "Iris reddish orange, shading to yellow near pupil. Feet magenta. Bill at base carmine, tips of both mandibles reddish white. Eyelids bluish flesh."

These five specimens and an additional one from Escuinapa present a decided average difference from Texan and east Mexican specimens in the amount of white on the wing. In four of these six specimens the greater coverts are more broadly edged with white than in any of a series of thirty-three specimens from Texas, Nuevo Leon, and Tamaulipas. The two other birds are intermediate in this respect but have more white than a majority of the eastern specimens, in many of which it is practically obsolete. There seems to be no other marked difference between the two series, although the Sinaloa birds appear to average paler, especially in the plumbeous areas, and the chin is usually whiter or less tinged with buff. In size there is little if any difference. There is thus in the paler colors and broader wing margins an evident approach to *C. f. madrensis* Nelson, from the Tres Marias Islands.

The southernmost representatives of this species probably constitute a distinct subspecies, as a single example (No. 45376) from Costa Rica is much smaller than Mexican and Texan birds, and the greater wing-coverts are wholly without light margins. Wing, 176.5 mm.

29. **Polyborus cheriway** (*Jacq.*). — Six specimens: Escuinapa, 5 specimens, January 24, March 18 and 28, May 20, June 30; Los Cabras Island, 1 specimen, April 8. One male (May 20), although apparently adult, is almost as brown as an immature bird and the abdomen is crossed by partially concealed buff bars. The specimen taken June 30 is a young bird "probably about 6 weeks old." Adult male, April 8: "Iris hazel. Feet and legs brownish orange. Bill pale bluish horn, shading to nearly white at tip. Cere and bare space

about base of bill dark reddish orange. Common." At Escuinapa: "Common. Nests in high trees. Nests found have but two chocolate colored mottled eggs or two young."

30. **Cerchneis sparveria phalœna** (*Less.*). — One female, Escuinapa, January 29. "Very common."

31. **Micrastur melanoleucus** (*Vieill.*). — Three specimens: Escuinapa, 1 adult male, April 8; Juanna Gomez River, 1 immature male, June 6; Juanna Gomez, 1 immature female, June 3. Adult male: "Iris grayish light brown, outside brownish blue. Feet greenish yellow; legs brownish yellow. Bill brownish black. Cere and bare space about eyes pale bluish yellow. Native name 'Guaco.'" Immature male and female: "Iris pale yellowish brown. Feet light greenish orange. Cere and bare space about eyes, yellowish green. Rather common."

The immature female is molting in wings (including remiges) and body plumage, acquiring black feathers above and pure white below. That white under parts are not peculiar to "very old birds," as has been stated (Sharpe, Cat. Bds. Brit. Mus., Vol. I, p. 75), but, on the contrary, may be present in the first adult plumage, is proved by this specimen.

32. **Asturina plagiata** *Schleg.* — Fourteen specimens: Escuinapa, 13 specimens, October 17, December 19–23, March 12–30, and June 26–July 2 (4 nestlings); Papachal, 1 adult male, December 9. "Eye large. Iris hazel" in both adults and immature, "grayish hazel" in young. Cere and feet "pale orange" to "brownish yellow." "Bill blackish." At Escuinapa: "Common; breeds in May." The usual number of eggs in a set is apparently two. The immature birds differ remarkably from the adults in their relatively much *longer* tails. Five adult males measure, wing 260 mm., tail 161, while five immature males give, wing 255, tail 183. This is also the case in *Urubitinga anthracina*, and doubtless in other hawks.

33. **Urubitinga anthracina** (*Licht.*). — Three specimens: Escuinapa, 2 specimens, December 22 and March 19; Arroyo de Limones, 1 adult female, April 20. Male immature, Escuinapa: "Iris yellowish brown. Feet brownish lemon. Bill dark horn, light at base; cere brownish lemon." Female adult, Escuinapa: "Eyes dark hazel; feet and cere lemon. Common. Preys principally on iguanas, lizards, snakes, frogs, large insects, rats, and mice. Found about river courses and lagoons."

34. **Urubitinga ridgwayi** *Gurney.* — Two adults: Escuinapa, 1

female, January 2; the other specimen is without label. "Iris light hazel. Feet brownish yellow. Bill blackish brown, base of lower mandible lighter. Common; breeds in April and May."

35. **Buteo abbreviatus** *Cab.* — One male, Escuinapa, January 13. "Iris dark hazel. Feet lemon. Bill horn; cere lemon."

36. **Parabuteo unicinctus harrisi** (*Aud.*). — Three specimens: Elota, 1 female, December 13; Escuinapa, 2 males, March 25–28. All three are in the mixed plumage of old worn feathers of the young bird and fresher feathers of the adult, apparently the "first nuptial plumage." March males: "Iris hazel. Feet and cere lemon. Bill bluish horn, tipped with black." The crop of one specimen (March 28) "contained a large field rat."

37. **Glaucidium phalænoides ridgwayi** (*Sharpe*). — Eight specimens: Escuinapa, 7 specimens, December 20–March 15, and July 4–15; Juan Lisiarraga Mt., 1 specimen, April 28.

A series of 57 specimens of *Glaucidium phalænoides* from throughout its range shows that the species is undoubtedly divisible into at least two geographical races, a fact long recognized by many ornithologists, but ignored in the Check-List of the American Ornithologists' Union. I am not certain as to the correct nomenclature of these subspecies, but use Dr. Sharpe's name of *ridgwayi* for the form under consideration.

Thirty specimens in the Museum collection from the southwestern United States, Tamaulipas, Sinaloa, Jalisco, and Yucatan are (with one exception described below) comparatively uniform in color and markings, the upper parts being olive brown to tawny brown and the tail rufous or ferrugineous crossed by eight to eleven blackish brown bars of about the same width as the rufous interspaces. Twenty-three specimens from South America (Trinidad, Colombia, Venezuela, and Brazil) present two very distinct color phases, neither of which closely resembles the birds from Mexico and the United States. The rufous phase, which evidently corresponds to the plumage of the northern form above described, differs conspicuously from the latter in the bright rufous shade of the entire upper parts, and in the more uniform tail in which the dark bars are more or less indistinct or even completely wanting. The other phase, represented by fourteen specimens, more nearly resembles the northern birds in color of upper parts but differs completely in color and pattern of tail, which is blackish, marked on each web by a series of six or seven transverse white spots which do not reach the shaft. Much variation exists, however, in some specimens the blackish being partly replaced by dark brown and the white tinged with ferrugineous or wholly replaced by it; and in some cases it is more in the form of bars than of spots, always narrower, however, than the dark interspaces. A curious specimen from Tamaulipas is the only one of the northern birds which approaches this phase. In it the upper parts are grayer than in the other birds from the same region, but while four or five of the rectrices of one side of the tail are marked as in the normal plumage the others have the white spots, etc., of the other phase. From any of the South American specimens in corresponding phase this specimen differs in the much grayer color of the upper parts. Of three specimens from Tehuantepec in the rufous plumage, two at least are referable to the South American form.

A male, Escuinapa, July 15, is molting the body plumage, wing-coverts, and remiges. "Common. Feeds and calls during the day. Its food is mice and large insects. Iris pale bright yellow. Bill pale whitish yellow. Soles brownish yellow, upper surface of toes greenish yellow."

38. **Speotyto cunicularia hypogæa** (*Bonap.*).—Thirteen specimens, Escuinapa, December 20–March 10. "Rather common."

39. **Ciccaba squamulata** (*Bonap.*).— Five specimens: Escuinapa, 4 specimens, March 12 and June 29–July 2; Juan Lisiarraga Mt., 1 specimen, April 30. The bird taken July 2 is a young female in juvenal plumage, the entire upper and under parts ochraceous buff, face and ruff whitish. The wings are little more than half grown, the tail a mere stub. It was doubtless only a day or two out of the nest. "Iris dark hazel. Bill pale brownish yellow. Feet brownish yellow. Rather common. Steady resident. Found in lowlands and to 6000 feet altitude."

It may be stated in this connection that a specimen from Honduras (Coroyal) appears to be intermediate in color and size between *Ciccaba squamulata* and *C. virgata.*

40. **Strix pratincola** *Bonap.*— Two specimens, Escuinapa, June 18 and July 4. "Rather common."

41. **Ara militaris** (*Linn.*).— Twenty-two specimens: Cyoatlan (600 feet), 1 specimen; Escuinapa, 16 specimens, October 27 and 28, December 30, January 7, March 10–29; and 5 specimens without labels. "Common; steady resident. Breeds in hollow trees in June. Remains in pairs the year round." Iris "pale yellow" in the December and January specimens, "reddish orange" in the March and October birds. "Space about eyes dirty white."

42. **Conurus canicularis** (*Linn.*). — Eleven specimens: Cosala, 4 specimens, November 30–December —; Elota (800 feet), 1 specimen, December 13; Escuinapa, 2 specimens, December 23 and January 2; Arroyo de Limones, 2 specimens, April 21; Juanna Gomez River, 2 specimens, June 9. "Iris narrow, light yellow. Space around eyes pale orange. Common. Breeds in June, nesting in hollow trees and in the large mud nests of ants" (Arroyo de Limones and Juanna Gomez).

43. **Psittacula cyanopygia cyanopygia** *Bonap.* — Twelve specimens: Cosala, 1 specimen, November 30; Escuinapa, 9 specimens, October 1–28, December 27, January 2, and May 31; Juanna Gomez River, 2 specimens, May 31 and June 4. Only three of these specimens are males. "Iris dark hazel. Feet pale whitish olive. Bill bluish white. Common on lowlands. Feeds on seeds and berries." I gather from the collector's notes that at Escuinapa this bird is migratory, the bulk of the species arriving in April or May. Two specimens, a male (October 15) and a female (October 28), are undergoing molt of the remiges, only the outer two primaries of each wing remaining.

44. **Amazona finschi** (*Scl.*). — Nine specimens: Cosala, 1 specimen, December 8; Escuinapa, 7 specimens, December 28–January 14, March 24 and 25; Juan Lisiarraga Mt., 1 specimen, April 27. "Common. Steady resident. Breeds in May and June, in hollow trees. Iris narrow, pale yellow. Feet dirty yellowish lead. Bill pale yellowish horn, tips of mandibles nearly white."

45. **Amazona albifrons albifrons** (*Sparrman*). — Twenty-two specimens: Elota (600 feet), 1 specimen, December 13; Escuinapa, 19 specimens, December 29–January 14, March 10–April 8, June 2–8; Juanna Gomez River, 2 specimens, June 1 and 2. "Common; breeds in hollow trees in May and June. Iris very narrow, pale yellow. Bill greenish yellow, tipped with light horn. Feet brownish olive."

This series shows that the White-fronted Parrot of southern Sinaloa differs from the birds of the same species occupying the region to the north and to the south, and may perhaps require separation. Specimens from southwestern Sonora (*A. a. saltuensis* Nelson) differ from southern Sinaloa birds in having the green of a darker, less yellowish shade and distinctly tinged with blue. Birds from Tehuantepec are somewhat smaller and decidedly darker, less *yellowish* green, than southern Sinaloa birds.

Birds of this species from Yucatan are so much smaller than those from other parts of Mexico that it seems desirable to take account of the fact in nomenclature, as follows:

Amazona albifrons nana, subsp. nov.

Chars. subsp.— Similar to *Amazona albifrons albifrons*, but smaller, with the exception of the bill.

Type, adult male, No. 66955, Amer. Mus. Nat. Hist.; Calotmul, Yucatan; Geo. F. Gaumer.

Dimensions of type: wing 155, tail 75.5, culmen 27.5, depth of bill at base 25.5.

Between the largest specimens examined from Yucatan and the smallest at hand from western Mexico, there is a considerable gap in measurements of wings and tail, the average difference, in the males, amounting to 24 and 17 mm. respectively. There is very little difference, however, in the size of the bill, that of the Yucatan form being disproportionately large.

There is, also, a decided difference in color between the Yucatan birds and the series from southern Sinaloa, the latter being of a lighter and more *yellowish* green. Tehuantepec specimens, although only a little smaller than Sinaloa birds, are nearer in color to those from Yucatan.

No locality being given in the original description of *Psittacus albifrons*, the typical form may be restricted to southwestern Mexico, as the specimen on which it was based most likely came from that region.

The following table shows the comparative measurements of the Yucatan, Tehuantepec, and Sinaloa birds:

	Wing.	Tail.	Culmen.	Depth of Bill at Base.
S. Sinaloa (16 ♂)	174–190 (183.4)	91–103 (96.7)	25–29 (27.6)	24.5–27.5 (26.7)
Tehuantepec (3 ♂)	173–178 (176.3)	91–102.5 (95.8)	28–29.5 (28.8)	27–29 (28)
Yucatan (2 ♂)	155–163.5 (159.3)	75.5–84 (79.8)	27.5–29 (28.3)	25.5–26 (25.8)
S. Sinaloa (6 ♀)	167–177 (172.8)	87–100.5 (91.8)	26–27.5 (26.9)	25.5–26 (25.8)
Yucatan (1 ♀)	154	80.5	27.5	26

46. **Coccyzus americanus occidentalis** *Ridgw.*— One specimen, Escuinapa, October 27.

47. **Piaya cayana mexicana** (*Swains.*).— Seventeen specimens: Caletie (400 feet), 1 specimen, December 18; Escuinapa, 14 specimens, September 13–November 4, December 20–January 13, March

3–25; Arroyo de Limones, 2 specimens, April 17 and 23. "Iris dark cherry red. Feet greenish lead" or "brownish black" in most cases. "Bill greenish black tipped with pale yellow. Common. Steady resident. Feeds on beetles, moths, butterflies, and berries."

I follow Dr. J. A. Allen[1] in considering this bird a subspecies of *Piaya cayana.* Salvin and Godman[2] also state that on the Isthmus of Tehuantepec, *P. mexicana* blends with *P. cayana.*

48. **Morococcyx erythropygia** (*Less.*).—One specimen, a female, Escuinapa, September 2. "Iris hazel. But one specimen seen to date."

49. **Geococcyx affinis** *Hartl.*—Three specimens: Escuinapa, 1 male, January 1; La Balla Mt. (4500 feet), 2 females, April 21 and May 10. For the latter locality the collector's notes are: "Not very common, steady resident, breeds. Iris pearly yellow." The Escuinapa specimen has nearly finished a complete molt.

50. **Crotophaga sulcirostris** *Swains.*—Seven specimens, Escuinapa, December 23–January 7, and March 12. Only one of these specimens is fully adult. The other six are apparently birds less than a year old. The maxillary grooves are shallow and short, not reaching nearly to the tomium, and the wings and tail are a mixture of old worn brownish and newer, unworn bluish quills. One of these birds, a male, December 20, is acquiring new remiges and rectrices. "Common. Native name 'Garropatero' (Tick Hunter). Iris hazel. Feet shiny black. Bill black."

51. **Trogon ambiguus** *Gould.*—Twenty-two specimens: Escuinapa, 10 specimens, October 26–31, December 28 and January 1, March 11–April 8; Arroyo de Limones, 1 specimen, April 16; Los Limones (3500 feet), 1 specimen, April 20; Los Pieles, 1 specimen, April 18; Juan Lisiarraga Mt., 6 specimens, May 9–12; Juanna Gomez River, 3 specimens, June 1 and 4. "Iris hazel; lids reddish orange. Feet pale greenish brown. Bill brownish yellow. Common. Steady resident in lowlands and foothills of Sierra Madre. Breeds in hollow trees, in May and June. Found in pairs or singly. Feeds on coleoptera and fruit. Pursues insects on wing and watches for them from lofty perches. Native name 'Co′-ah,' from its principal note (quickly and loudly repeated four or five times)." All the April and May specimens show molt taking place on throat and breast.

52. **Trogon citreolus** *Gould.*—Thirteen specimens: Escuinapa, 5 specimens, September 19 and December 20–28; Los Pieles, 5 speci-

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[1] Bull. Amer. Mus. Nat. Hist., Vol. V, 1893, pp. 137, 138

[2] Biologia Cent. Amer., Aves II pp. 530, 531.

mens, April 16–23; La Balla (5500 feet), 1 specimen, May 11; Juan Lisiarraga Mt., 2 specimens, May 12 and 14.

"Iris very narrow, pale yellow. Feet dark yellowish olive" or "brownish black." "Bill pale lead" or "bluish white." "Common. Found from sea-level to 6000 feet. Nests in hollow trees in May and June. Pursues insects on wing like Flycatchers. Food, beetles and other large insects, berries and fruit."

As has been pointed out by Messrs. Salvin and Godman, the birds from the northern part of the range of this species differ from those further south in the presence usually in the male of bluish green on the head and sides of the breast. The present series shows great variation in these respects, however. Four specimens have the occiput (and one the center of crown) decidedly bluish green, while in the others this tint is very faint or wholly wanting. The same four specimens have the sides of the breast strongly tinged with bluish green, which in one bird forms a narrow band nearly or quite complete across the breast, and most of the others have at least a trace of this color on sides of breast. The northern birds also average considerably smaller throughout than those from Tehuantepec, etc. A female (No. 91311), Juan Lisiàrraga Mt., May 12, is remarkable in having the outer web of outer rectrix more extensively black than usual, the black being in the form of bars (confluent at shaft) for the last (distal) three centimeters. A male dated September 19 is undergoing a general molt, including wing and tail.

53. **Momotus mexicanus saturatus** *Nelson.*—Seven specimens: Escuinapa, 1 specimen, December 28; Los Pieles, 2 specimens, April 23; Sierra de Armigas (3500 feet), 3 specimens, May 9; Juanna Gomez River, 1 specimen, June 4. "Iris reddish hazel. Feet heavy, fleshy, brownish olive. Bill brownish black. Native name 'Tur'-co.' Common. Arrives in April. Breeds in burrows of old kingfishers' nests; also digs holes in banks, generally over water. Nests also in and under hollow logs or under stones on level ground. Male assists in incubation. Has but two low guttural notes. Found singly or in pairs. Food, beetles and other insects, berries and fruit. Inhabits open glades in low shady woods or bushes."

The December specimen, a female, which is apparently a bird-of-the-year, is acquiring one new middle rectrix. Its iris is described as "dirty white shading from outer edge to light hazel. Legs dark blackish brown."

54. **Ceryle americana septentrionalis** *Sharpe.*—Four specimens: Arroyo de Limones, 3 specimens, April 20 and 23; Escuinapa, 1

specimen, October 14. "Iris hazel. Bill and feet brownish black. Common. Breeds."

55. **Ceryle amazona** (*Lath.*).—One male, Escuinapa, June 2. "Iris hazel. Feet and bill brownish black."

56. **Chloronerpes godmani** *Hargitt.*—One specimen, a male, of this rare species, Juan Lisiarraga Mt., May 2. "Iris reddish hazel. Feet yellowish olive. Arrives in April, but few seen. Feeding in oaks."

57. **Centurus uropygialis** *Baird.*—Thirteen specimens: Escuinapa, 12 specimens, December 20–April 2; Juanna Gomez River, 1 specimen, June 8. A male, taken March 24, has the yellow of belly strongly tinged with reddish orange. "Common, steady resident; breeds in May. Iris reddish hazel."

58. **Centurus elegans** (*Swains.*).—Twenty specimens: Escuinapa, 13 specimens, December 20–March 1; Los Pieles, 5 specimens, April 18 and 19; Juanna Gomez River, 1 specimen, June 1. "Common, from sea to 5000 feet altitude; steady resident; breeds in May and June. Native name, 'Cha′-co.' Iris reddish brown. Bare space around eye dark brownish olive." In two specimens, the partly concealed black bars of sides of breast are more strongly developed than usual.

59. **Ceophlœus scapularis** (*Vig.*).—Nine specimens: Escuinapa, 6 specimens, December 28, February 19–April 8; Juanna Gomez River, 3 specimens, June 1 and 2. The color of the iris is given variously as "pearl," or "pale whitish yellow"; feet "dark blackish green," or "greenish lead"; bill "yellowish white" or "bluish white." In only one specimen, a male, is the whitish facial stripe unbroken, and in this it is very narrow.

60. **Dryobates scalaris sinaloensis** *Ridgw.*—One specimen, a female, Juan Lisiarraga Mt., April 27. "But one specimen seen. Iris dark hazel."

61. **Campephilus guatemalensis guatemalensis** (*Hartl.*).—Eight specimens: Brazil (800 feet), 1 specimen, December 17; Escuinapa, 4 specimens, January 30–February 22; Las Cabras Islands, 1 specimen, April 8; Juan Lisiarraga Mt., 2 specimens, May 10. "Common; breeds in May" (Juan Lisiarraga Mt.). "Iris pale yellow. Bill bluish white" or "dirty white, bluish at base."

62. **Chordeiles acutipennis texensis** (*Lawr.*).—One specimen, a male, Escuinapa, December 28. "Iris hazel."

63. **Nyctidromus albicollis merrilli** *Senn.*—Three specimens, Escuinapa, October 17, March 22, and August 30. "Common. Steady

resident. Iris hazel." The August bird, a male, is undergoing a complete molt.

64. **Antrostomus ridgwayi** *Nelson.* — One specimen, a male, Los Pieles, April 23.

This is, I believe, the first male of this species to be recorded. Dr. Chas. W. Richmond has compared this specimen with the type, a female, and states that the general tone of coloration is like the type, the differences between the two birds being slight.

65. **Amizilis beryllina viola,** subsp. nov.

Chars. subsp.—Similar to *Amizilis beryllina beryllina*, but with upper tail-coverts and tail more violet.

Type, adult male, No. 91380, Amer. Mus. Nat. Hist.; Jalpa, Sinaloa, Mexico, April 18, 1904; J. H. Batty.

Twenty-two specimens, as follows: Jalpa (3000 feet), 8 specimens, April 16–19; Los Pieles, 1 specimen, April 18; Los Limones (3500 feet), 2 specimens, April 20 and 22; Juan Lisiarraga Mt., 6 specimens, May 10–12; La Balla (5500 feet), 5 specimens, May 2–12. "Common. Breeds in May and June. Found from nearly sea-level to 6000 feet."

Only four of these specimens (La Balla, April 2 and 3) are females. Mr. Salvin[1] has called attention to the variations in the color of the tail and upper tail-coverts in this species. He states: "I am unable to trace these variations to any definite localities, but the darker specimens, as a rule, are from the more northern part of western Mexico. This, however, is by no means universally the case."

All of these Sinaloa birds, and others from Jalisco, have the upper tail-coverts and the tail more or less deep violet purple, while of a smaller series from other parts of Mexico not one is thus colored. It, therefore, seems to me that the birds from western Mexico are entitled to recognition as a subspecies. In typical specimens of *viola*, the color of the tail is very near "plum purple" of Ridgway's 'Nomenclature of Colors,' more purple in certain lights, while the upper coverts are still bluer. There are also several other differences which are not altogether constant. Compared with typical *beryllina*, the Sinaloa specimens have the under tail-coverts darker, less rusty brown, and abruptly margined with whitish, the green of the anterior under parts extends further down on the belly, and the latter is usually very little, if at all, tinged with cinnamon. The green of the upper and under surface is also of a less golden or coppery shade.

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[1] Catalogue of the Birds in the British Museum, XVI, p. 210.

Specimens of the typical form have been examined from Vera Cruz, Oaxaca, and Morelos. A bird from Moro Leon, Guanajuato, appears to be somewhat intermediate between the two races.

66. **Amizilis cinnamomea cinnamomea** (*Less.*). — Ten specimens: Escuinapa, 7 specimens, October 1, November 1, December 22–January 13, March 12; Arroyo de Limones, 3 specimens, April 21–23. One is not marked as to sex, of the remainder all but two are males. "Iris hazel. Bill dark reddish flesh, tipped one-third its length with brownish black; soft and fleshy. Common; breeds in July."

67. **Uranomitra verticalis** (*Licht.*). — Ten specimens: Escuinapa, 5 specimens, December 20–January 13; Juan Lisiarraga Mt., 5 specimens, April 30–May 12. Seven specimens are males, three females. Adult male, December 20: "Iris dark hazel. Bill dark flesh, tip for one-eighth inch brownish black. Stomach contained insects." Juan Lisiarraga Mt.: "Not very common. Feeds on insects in high trees and among blossoms of parasitic plants in oak trees."

68. **Iache latirostris** (*Swains.*). — Seven specimens: Escuinapa, 6 specimens, November 1 and December 22–January 13; Los Pieles, 1 specimen, May 21. At latter locality, "not as common as other species. Iris dark hazel." At Escuinapa: "Common. Breeds in July."

Specimens of *Iache latirostris* from southern Sinaloa average smaller than those from any other part of the bird's range, as shown by the following table:

	Wing.	Bill.
Average of 2 ad. ♂ from Nuevo Leon,	52.2	20.1
" " 5 " " " Arizona,	51.5	21.
" " 1 " " " Valley of Mexico,	52.	—
" " 4 " " " Colima,	50.6	20.
" " 6 " " " Jalisco,	51.4	20.5
" " 4 " " " S. Sinaloa,	49.6	19.2
Type of *I. magica* from S. Sinaloa,	50.	18.2
" " *I. latirostris* from "Mexico,"	52.7	19.7
Average of 2 ad. ♀ from Nuevo Leon,	50.3	20.9
" " 4 " " " Arizona,	50.1	21.6
" " 1 " " " Jalisco,	50.5	21.7
" " 3 " " " S. Sinaloa,	48.7	19.2

The type of *Iache magica* (Muls. et Verr.), which is now before me, agrees very nearly in size with the Sinaloa specimens of *latirostris*. It differs conspicuously from them, however, in color. The upper parts are a reddish bronze, very different from the green or bronzy green of *I. latirostris*, the under parts are a mixture of bronzy green and coppery bronze, and the throat is mostly green instead of blue.

Apparently no other specimen similar in color to the type of *magica* has ever been obtained and I am of the opinion that this bird is merely an abnormal specimen of *I. latirostris*. If this is so, the claim of the Sinaloa birds as a distinct subspecies rests wholly on their slightly smaller size, for, as far as I can see, there is no difference in color between these smaller specimens and birds from other localities. There seems to me hardly enough difference in size to warrant the separation of the Sinaloa birds.

69. **Anthoscenus leocadiæ** (*Bourc. et Muls.*).—Nine specimens: Escuinapa, 1 specimen, January 24; Los Pieles, 1 specimen, April 15; Juan Lisiarraga Mt., 7 specimens, May 9–12. "Iris dark hazel. Rather common."

Five of these specimens have the white tip of the outer rectrix without even a trace of a dark marking. In the four remaining birds, there is a small and inconspicuous dusky spot at the edge of the outer web. One specimen from Tehuantepec City and two without exact locality have this spot conspicuous,—larger, darker and nearly connected along the edge of the outer web with a dark line which extends down from the dark portion of the feathers. This dark line is evident in only one or two of the Sinaloa birds. In *Anthoscenus constanti*, from Guatemala and Costa Rica, these marks are blacker, more sharply defined, and usually perfectly confluent.

70. **Trochilus colubris** *Linn.*—One specimen, a female, Escuinapa, October 1. "Common." Molt is taking place in the tail of this specimen.

71. **Stellula calliope** (*Gould*).—One specimen, Los Pieles, April 17.

72. **Dendrornis flavigaster mentalis** (*Lawr.*).—Eleven specimens: Los Pieles, 1 specimen, April 18; Arroyo de Limones, 2 specimens, April 21 and 23; Juan Lisiarraga Mt., 7 specimens, April 12, May 12 and 13; Juanna Gomez River, 1 specimen, June 3. "Iris reddish hazel. Feet brownish olive. Common. Feeding in oak timber."

Judging by this series and by other birds in the Museum collection, the bird of western Mexico is recognizably distinct as a subspecies from typical *D. flavigaster*. In addition to the usually grayer, whiter-striped under parts and paler upper parts, the marking of the throat furnishes a good character. In typical *D. flavigaster*, the throat is immaculate for a distance of 20 mm. *or more* from base of gonys, in *D. f. mentalis* for only 15 mm. or *less*.

73. **Tityra personata griseiceps** *Ridgw.*—Nine specimens: Los Pieles, 7 specimens, April 14–17; Juan Lisiarraga Mt., 2 specimens, April 14 and 16. "Iris reddish hazel. Feet blackish lead. Bare

space about eyes pale magenta. Base of mandible dark magenta. Common. Mating. Feeds on beetles and berries."

74. **Platypsaris albiventris** (*Lawr.*).— Two specimens, Escuinapa, December 30 and March 11. Adult male, March 11: "Iris hazel. Feet blackish lead. Bill medium horn."

75. **Attila cinnamomeus** *Lawr.*—One specimen, Sierra de Juan de Lisiarraga, May 8. "Iris pale orange. Feet and legs purplish lead."

76. **Pyrocephalus rubineus mexicanus** *Scl.*— One specimen, Escuinapa, January 13.

77. **Empidonax difficilis** *Baird.*— Six specimens: Escuinapa, 5 specimens, October 27 and December 21–January 7; Juan Lisiarraga Mt., 1 specimen, April 27. "Common."

78. **Horizopus richardsonii richardsonii** (*Swains.*).— Five specimens, Juan Lisiarraga Mt., April 26–May 16. "Common."

Four of these specimens are typical, but the fifth (No. 91467, adult ♀, May 12) presents peculiarities of size and color worthy of mention. In the first place, it is a remarkably small specimen, the wing measuring but 78.5 mm. and the tail 59.5. In a series of about 125 specimens before me, only two other birds measure less than 80 mm. in length of wing, one from Colusa Co., California, and one from north Chihuahua, which measure respectively, wing 79.5, tail 60, and wing 79, tail 61.7. The bill is unusually short and broad, measuring, exposed culmen 11.5, breadth at base 8.5. The average dimensions given by Ridgway in his 'Manual' (reduced to millimeters) are 12.2 x 7.4.

In coloration this bird cannot be quite matched by a single specimen in the large series above mentioned. The upper parts, especially the back, are browner than any other bird in the series; nor does it agree with the greener color of *H. virens*. The under parts are very dark, the entire throat and belly strongly yellowish, while the dark breast has a decided ochrey brown tinge. The under wing-coverts are also decidedly ochraceous tinged. A few specimens from California and Arizona closely approach this one in color of upper parts, but not one of them has the brownish ochrey tinge on the breast. The two small specimens above referred to do not approach the Sinaloa bird in coloration, and of those which approach it in color only one (♀ ad., Arizona, June 14, wing 80, tail 61.5) comes near it in size.

I provisionally refer this bird to *richardsonii*, but think that it may eventually be found to represent a distinct subspecies resident in southern Sinaloa.

79. **Sayornis nigricans nigricans** (*Swains.*).—Two specimens: 1, Escuinapa, October 21; the other without data. The under tail-coverts of both birds are pure white, except for a dusky shaft-streak towards the base of the longer feathers.

80. **Myiarchus lawrenceii olivascens** *Ridgw.*—Eleven specimens: Escuinapa, 5 specimens, September 13, October 31, December 21, January 30, March 25; Los Pieles, 1 specimen, April 16; Juan Lisiarraga Mt., 5 specimens, April 27–May 12. "Common; steady resident." These specimens are slightly larger than Arizona birds, their bills are blacker, especially the lower mandible, and the upper parts are slightly greener, the crown in particular being less brownish, its feathers with more fuscous centers and more olivaceous margins. The September specimen is undergoing a complete molt.

81. **Myiarchus nuttingi inquietus** (*Salv. & Godm.*).—Four specimens, Escuinapa, December 21, January 2, March 23 and 24. "Common. Iris hazel."

82. **Myiarchus cinerascens cinerascens** (*Lawr.*).—Seven specimens: Escuinapa, 5 specimens, August 6 and 16, October 20 and 29; Los Pieles, 1 specimen, April 16; Juan Lisiarraga Mt., 1 specimen, May 12. "Common; steady resident; breeds." The two August specimens are in an advanced stage of the post-juvenal molt, including wings and tail.

83. **Myiarchus mexicanus magister** *Ridgw.*—One specimen, Escuinapa, July 7.

84. **Myiodynastes luteiventris** *Scl.*—Nine specimens: Juan Lisiarraga Mt., 6 specimens, April 29–May 8; Juanna Gomez River, 3 specimens, June 2 and 4. "Common; breeding. Arrives in April. Feeds on berries and insects. Iris hazel."

These birds have slightly smaller bills than specimens from northeastern Mexico, and the feather margins of the back average a trifle paler, less fulvous brown. The differences, however, are too slight and inconstant to warrant subspecific separation.

85. **Myiozetetes similis superciliosus** *Bonap.*—Four specimens, all females, Escuinapa, December 20–January 30, March 4. "Common. Iris hazel."

86. **Pitangus derbianus derbianus** (*Kaup.*).—Seventeen specimens: Escuinapa, 15 specimens, December 20–January 30, March 13, and (4 nestlings) July 2 and 3; Los Pieles, 2 specimens, April 15 and 22. "Common from lowlands to 5000 feet; steady resident. Breeds in April and May; nest often placed in trees over water."

Winter birds from Texas and eastern Mexico, compared with this series, have the back slightly lighter and browner. Molt is taking place in the body plumage of the two April birds.

87. **Megarhynchus pitangua** (*Linn.*).—One specimen, Juan Lisiarraga Mt., April 27. "Iris hazel. Feet blackish brown. Bill solid brownish black."

I have no other specimens from western Mexico, but compared with a large series from other parts of the bird's range, the bill of this individual is of maximum length, measuring 26.8 from nostril; wing (worn), 117.5.

88. **Tyrannus vociferans** *Swains.* — One specimen, Escuinapa, January 29.

89. **Tyrannus verticalis** *Say.*— Three specimens, Los Pieles, April 18. "Common. Probably a migrant; first seen in April."

90. **Tyrannus melancholicus couchii** (*Baird*). — Four specimens: Escuinapa, 3 specimens, March 30 and July 5; Juanna Gomez River, 1 specimen, June 1. "Native name, 'Cor're Gavilan' (Chase-hawk). Arrives in April."

91. **Tyrannus crassirostris** *Swains.*— Nine specimens: Escuinapa, 8 specimens, December 20–January 30, March 10–April 2; Sierra de Juan de Lisiarraga (5500 feet), 1 specimen, date not given, but probably about May 8. At Escuinapa: "Rather common. Iris dark hazel. Bill dark horn" to "brownish black. Feet brownish black." On the label of a male, April 2, the collector states: "This bird had but one leg when shot." Trace of the missing leg is seen in a stump about 18 mm. long, ordinarily concealed in the plumage. Judging from its appearance, the leg was probably lost through some accident not many weeks before the bird was collected.

92. **Cissilopha beecheii** (*Vig.*). — Seven specimens: Caletie (400 feet), 1 specimen, on or about December 18; Escuinapa, 4 specimens, December 28, March 27 and 30; Juanna Gomez River, 2 specimens, June 1. Escuinapa specimen: "Iris hazel. Feet brownish yellow. Bill black." The two birds from Juanna Gomez River had the iris "greenish yellow." "Common in wooded districts in lowlands and to 6000 feet in Sierra Madre. Probably found only on west side of Sierra Madre. Breeds in May and June. Noisy."

93. **Calocitta colliei** (*Vig.*). — Twenty specimens: Elota (800 feet), 1 specimen, December 13; Escuinapa, 19 specimens, December 28–April 2, June 30 (nestling). "Iris hazel. Feet shiny black. Bill dull black. Common in foothills of western slope of Sierra Madre. Breeds in April and May. Nest, placed in high trees, resembles a Magpie's, composed of sticks and lined with grass and leaves. Native

name 'Carra'ca.'" On another label, the native name is spelled "Gu-ra′-ca."

Two nestlings in juvenal plumage agree with Ridgway's description[1] of the young bird, but in addition to wanting the blue superciliary spot (which, however, is faintly indicated in one specimen) the suborbital spot is also absent. The white-tipped crest feathers of the young bird are apparently worn for a longer time than the rest of the juvenal (body) plumage, for four females in the Museum collection taken November 26 to January 2, and one from Mazatlan dated "February," have all the old white-tipped crest feathers, though the blue spots above and below the eye are present and the body plumage in general is like that of the adult.

The adults present a large amount of variation in the markings of the head and breast. The blue malar patch is more or less mixed with blackish in several specimens and in others the feathers are more extensively white basally. In six specimens the black of the breast is mixed with blue and white, the feathers being irregularly particolored. In no case does this mottling reach to the posterior edge of the black area, a narrow black crescent always being left. In a Durango specimen, the whole throat and chest are white, the black remaining only on the chin and in the form of a black crescent across the breast. The lower surface of this bird bears a striking resemblance to that of *Calocitta formosa*. But as stated by Ridgway (Birds of North and Middle America, Part III, p. 294), this must apparently be accounted for by individual variation, as it cannot be explained by hybridization or intergradation with *C. formosa*.

94. **Corvus mexicanus** *Gmel.*—Twenty-one specimens: Escuinapa, 19 specimens, December 23–January 1, March 15–April 2; Juanna Gomez River, 2 specimens, June 1. "Iris dark hazel. Feet shiny black. Bill black. Very common. A very noisy bird. Feeds on grain and fruit. Much disliked on account of its fruit-destroying habits. Builds a rather large nest of sticks, leaves, and grasses in trees."

95. **Corvus corax sinuatus** (*Wagl.*).—One specimen, Arroyo de Limones, April 21. "Generally seen in mountains, in pairs."

96. **Megaquiscalus major graysoni** (*Scl.*).—Twenty-two specimens: Escuinapa, 20 specimens, December 20–January 22, March 24–April 2, June 8; Juanna Gomez River, 2 specimens, June 1. "Very common. Steady resident. Breeds in May and June. Nests in bushes and rushes. A pest in the fruit season."

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[1] Birds of North and Middle America, Part III, p. 294.

The 12 males of this series are all fully adult birds. A female, taken December 24, is in a very curious albinistic plumage. The entire plumage is of a brownish ashy shade. The wings and tail are less brownish and crossed by numerous dusky or dark brown bars, the interspaces on the exposed portions of wing and tail being almost whitish. The body feathers are silky whitish towards the base. The iris was "yellowish white."

97. **Sturnella magna mexicana** (*Scl.*).—One specimen, a male, Escuinapa, January 13. This is a very dark, richly colored specimen. Measurements: wing, 113.3; tail, 73.8; culmen from base, 32; tarsus, 39.4.

98. **Agelaius phœniceus sonoriensis** *Ridgw.*—Two specimens, both females, Escuinapa, January 2.

99. **Cassiculus melanicterus** (*Bonap.*).—Ninety specimens: Cosala, 1 specimen, December 8; Escuinapa, 59 specimens, October 21–November 1, December 20–January 30, March 1–April 11; Arroyo de Limones, 3 specimens, April 16 and 17; Juanna Gomez River, 27 specimens, June 1–9. "Very common steady resident [in lowlands], migrating in summer to 4000 feet in Sierra Madre Mts. Breeds in colonies, in May and June. Has long, purse-like, hanging nest of green grass interwoven with other vegetable fibers, with a cushion of loose leaves in bottom, generally suspended over water, often on royal palms or thorny sarrataderas. Feeds on fruit, fruit buds, hearts of flowers, and insects. Has many peculiar notes. Native name 'Chin-Galindi'na.' "

The iris is recorded as "hazel," and the feet as "shiny brownish black." The color of the bill, both in life and in the dried skins, is subject to much variation, apparently purely individual. It is recorded by the collector in most cases as "bluish white" or "greenish white." In most specimens the color is greenish white (or greenish ivory white), usually decidedly shaded with greenish plumbeous at base of bill and with a touch of the same color on the terminal half or one-third of the culmen. In many specimens this plumbeous shade exceeds the lighter color in extent and in some the bill is entirely lead color. One such dark-billed specimen, and others less extreme, had that member "pale bluish white" in life, according to the collector, but judging by other white-billed specimens long in the collection such a change does not always take place.

Examination of this large series and other specimens in the Museum collection reveals the fact that the young males in their second year resemble the females in plumage, averaging decidedly larger, however, a fact apparently not previously recorded. Fourteen females measure as follows: culmen, 33.5–36.4 (34.6); wing, 121.5–132 (127.3); tail, 102.5–110.5 (107.2); and twelve immature males measure as follows (wing measurements of 3 specimens and tail measurements of 2 of these same specimens omitted owing to greatly worn feathers): culmen, 37.5–40 (38.9); wing, 138.5–143 (140.7); tail, 115–123.8 (119.7). The measurements of "adult female" given by Ridgway[1] evidently include those of the young males. Of the twelve young males in this series, all but one have a trace of the adult plumage, usually a few black feathers scattered in the plumage of the under parts, and in two cases a black rectrix. These black feathers were apparently assumed at the same time as were the brown feathers. In only one bird (June 8) can I find molt taking place, a few black feathers coming in among the breast plumage. The six October and November specimens, all adult males, are all in the final stage of the annual molt. One of these specimens is remarkable for having a number of the black flank feathers on both sides conspicuously marked with yellow.

Of the 90 birds in this series, 63 are adult males, 12 immature males, and 15 females. Several specimens have a diseased condition of the tarsus, and in one the basal portion of the upper mandible also, being, according to the collector, "poisoned by the ava tree, a common occurrence."

100. **Icterus bullockii bullockii** (*Swains.*). — One specimen, an adult male, Escuinapa, October 21. It is possible that the three specimens recorded under the next subspecies are really typical *bullockii.*

101. **Icterus bullockii abeillei** (*Less.*). — Three specimens: Juan Lisiarraga Mt., May 10 and 11, two females; Escuinapa, October 31, an immature male. I refer these three birds only provisionally to *abeillei*, as it is possible that they are really *bullockii bullockii*. Durango specimens of this species prove the intergradation of *Icterus abeillei* and *I. bullockii*.

102. **Icterus pustulatus** (*Wagler*). — Seventy-four specimens: Escuinapa, August 6, (1 specimen), October 26–29 (5 specimens), December 19–March 30 (50 specimens), and May 31–June 15 (3 specimens); Arroyo de Limones, 1 specimen, April 16; Juanna Gomez River, 14 specimens, June 1–6. "Steady resident; very common. Most common on lowlands, up to 3500 feet. Breeds May 25 to August. Native name 'Mon-ti-ca′-ro.' Iris hazel."

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[1] Birds of North and Middle America, Part II, p. 191.

Of these 74 specimens, 43 are adult males, 16 immature males, 1 young male, 8 adult females, 6 immature females. The immature female (in first winter and first nuptial plumages) differs from the adult female and immature male in paler and duller colors. The upper parts are more constantly grayish (and this is a more *brownish* gray), the streaks obscure, never (?) distinctly blackish, black of throat and lores duller and usually more restricted. The August specimen is molting from juvenal to first winter plumage, the wings and tail not being included in the molt.

103. **Icterus cucullatus nelsoni** *Ridgw.* — Fourteen specimens, Escuinapa, October 24 (one), January 22–30, and (one) February 24. Eight of the nine adult males measure as follows: wing, 86.5–91.4; tail, 91.2–95.6. The remaining specimen measures, wing, 81.3; tail, 83. It is also decidedly paler than the others. It cannot be referred to any other known subspecies, being typically *nelsoni* in coloration, and may represent an undescribed, slightly differentiated, smaller race. The shortest-winged specimen in the Museum series of 60 adult males (mostly from Arizona, with some from California and Lower California) is one from Arizona with wing, 85; tail, 87.5; the minimum wing measurement given by Ridgway (Birds of North and Middle America) is 86.4.

In this connection, I may call attention to the fact that Lower California specimens have decidedly longer bills than those from other localities, as I have not seen this mentioned by any writer.

104. **Icterus spurius** (*Linn.*). — Eleven specimens, Escuinapa, September 11–October 25. "Arrives from north first week in September. Common."

Eight of these are adult males, two are marked female, and one is marked young male. The adult males vary much in the depth of the chestnut of rump and under parts, and also in the amount and shade of the pale feather-tips of both upper and under parts. All of them are in winter plumage. The six collected from September 11 to October 2, also the two females and the immature male (September 19 to October 9) are all in the final stage of the molt, the remiges and rectrices having all been renewed, the outermost not having attained their full growth. The adult males dated October 9 and 25 have completed the molt.

The young male has the back tinged with brown, the chest strongly tinged with ochraceous, and the chin and throat sparsely marked with blackish. The color of the bill and the color and condition of the primary coverts indicates that this is actually a bird-of-the-year. It is undergoing a complete molt with the exception of the primary coverts.

One of the two females, likewise a bird-of-the-year, is molting the entire plumage with the exception of the primary coverts.

105. **Tangavius æneus æneus** (*Wagl.*).—Eleven specimens: Escuinapa, 9 specimens, December 22 and 27, March 23–April 2; Juanna Gomez River, 2 specimens, June 1 and 2. "Common. Native name 'Tol′-do.'" The color of the iris is given as "pale brownish red" in the December males; in the June males (fully adult) "grayish mottled with orange," and "pearl yellow"; in the females, "pale grayish yellow," "pale grayish yellow, mottled with reddish brown," and "pale brownish red."

106. **Molothrus ater obscurus** (*Gmel.*).—One specimen, a male, Escuinapa, December 26. "Common winter resident." Wing, 102.5; tail, 71.3.

107. **Calamospiza melanocorys** *Stejn.*—One specimen, a female, Escuinapa, December 20.

108. **Spiza americana** (*Gmel.*).—Eleven specimens, Escuinapa, August 15 and 16, October 1–27. "Arrives in August, leaves in April. Not observed breeding. Common in fields and bunches of low brush."

109. **Volatinia jacarini splendens** (*Vieill.*).—Four specimens, all adult males: Juanna Gomez River, 1 specimen, June 2; Escuinapa, 3 specimens, August 16–20. "Iris hazel. Feet brownish black. Bill brownish black, lower mandible nearly white at base. Common. Arrives in May. Feeds in weeds, low bushes, hedges, etc. Rather wild." Molt is taking place in the body plumage and tertials of the June bird.

110. **Sporophila torqueola** (*Bonap.*).—Two specimens, both males, Escuinapa, February 12 and August 16. The following note refers to the August bird: "Iris hazel. Feet blackish brown. Bill brownish black. Arrives in April. Common."

111. **Cyanospiza ciris** (*Linn.*).—Five specimens (4 adult males and 1 female), Escuinapa, October 2–November 1, January 2, and March 19. "Stragglers, only seen in winter months."

112. **Cyanospiza versicolor pulchra** (*Ridgw.*).—Six specimens: Escuinapa, 5 specimens (2 females, 3 males), November 1, December 27 and 28, March 28; Juanna Gomez River, 1 male, June 1. "Rather common." Male, December 27: "Iris hazel. Feet brownish black. Bill medium horn, lower mandible nearly white at base." Adult male, March 28: "Iris hazel. Feet pale reddish brown. Bill pale horn, lower mandible lightest."

In size, and in form of bill, these specimens agree rather closely with Lower California birds, but in color appear to be intermediate between *C. v. versicolor* and typical *C. v. pulchra.*

113. **Cyanospiza cyanea** (*Linn.*).—One specimen, a female, Escuinapa, October 25. "Common. Feeds on seeds of weeds."

114. **Cyanocompsa parellina indigotica** (*Ridgw.*).—One specimen, a female, Escuinapa, December 29. "Iris hazel. Feet blackish brown." This specimen measures as follows: wing, 68.5; tail, 54.5; culmen from base, 12.1.

115. **Guiraca cærulea lazula** (*Less.*).—Six specimens: Escuinapa, 4 specimens, October 20 and 25, December 20 and 23; Arroyo de Limones, 2 specimens, April 16 and 20. An adult male, dated October 20, is in an advanced stage of the postnuptial molt. In a male, December 23, the feathers of the interscapulum are so broadly tipped with brown as to wholly conceal the blue beneath.

116. **Zamelodia melanocephala** (*Swains.*).—One specimen, Escuinapa, October 10. "Arrives from north last of September. Not a steady resident."

117. **Pheucticus chrysopeplus** (*Vig.*).—Fourteen specimens: Escuinapa, 5 specimens, October 27 and December 20–22; Juanna Gomez River, 9 specimens, June 1–6. "Iris hazel. Feet pale greenish blue. Common. Inhabits lowlands from the Pacific to 3500 feet altitude. Arrives in April, breeds in June. A fine singer." A specimen marked male (if so, an immature bird) and dated October 27 is in the midst of a molt which involves the remiges but not the tail.

118. **Pyrrhuloxia sinuata sinuata** *Bonap.*—Two specimens, Escuinapa, a male, December 21, and a female, January 1. "Common." The male, apparently a bird-of-the-year, is very small, measuring, wing 87, tail 98, culmen from base 15. If the bill were slightly larger, this specimen would agree with *P. s. peninsulæ.* The female measures, wing 92, tail 104, culmen from base 15.

119. **Saltator plumbiceps** *Lawr.*—Five specimens: Escuinapa, 4 specimens, September 13, December 20, January 22, and February 24; Juanna Gomez River, 1 specimen, June 2. "Common; most numerous in summer, stragglers seen in winter months; breeds. Iris hazel." The June specimen, an immature bird, is molting the body plumage and tail, the old worn olive green feathers on the crown giving place to fresh gray feathers. The September bird is molting from juvenal to first winter plumage.

120. **Oreospiza chlorura** (*Towns.*).—Six specimens, Escuinapa,

October 27, December 20–26, and (one specimen) March 18. "Common; arrives in September, leaves in April; not observed breeding."

121. **Arremonops superciliosus sinaloæ** *Nels.*—Two specimens: Escuinapa, a male, May 31; Juanna Gomez River, a female, June 2.

122. **Melospiza lincolnii lincolnii** (*Aud.*).— Five specimens, Escuinapa, October 31, December 28, February 2, March 10 and 28. "Common winter resident. Arrives in October."

These specimens are referable to true *lincolnii* and not to *striata*, which I consider a good subspecies. Two are marked female, the three others male, and they measure in length of wing 63.5, 60, 61, 62, and 62 mm. respectively. One specimen (male, March 28) has the white throat practically immaculate, but a few faint dusky specks are visible on close examination. The chest is also more sparsely and faintly streaked than usual.

123. **Amiophila rufescens pallida** *Nels. & Palmer.*— One specimen, a male, Juan Lisiarraga Mt., April 29. "Iris reddish hazel. Feet brownish white." The measurements of this specimen are as follows: wing, 76; tail, 77; exposed culmen, 15.7; depth of bill at base, 10.1; tarsus, 24.3; middle toe (without claw), 18.7.

124. **Spizella pallida** (*Swains.*).—One specimen, a male, Escuinapa, December 27. "Iris hazel. Feet brownish flesh. Upper mandible reddish horn, lower mandible flesh color."

125. **Zonotrichia leucophrys leucophrys** (*Forst.*).—One specimen, an immature male, Escuinapa, February 24.

126. **Chondestes grammacus strigatus** (*Swains.*).— Seven specimens, Escuinapa, October 20–November 1, December 27–February 2. "Arrives in September or October; leaves lowlands in April and May." The February specimen, a male, is pale and gray above, with wing measuring 92 mm.

127. **Coturniculus savannarum bimaculatus** (*Swains.*). — Two specimens, Escuinapa, October 20 and February 2. "Common."

128. **Passerculus sandwichensis alaudinus** (*Bonap.*). — Two specimens, Escuinapa, December 21 and February 2.

129. **Piranga rubra cooperi** *Ridgw.* — One specimen, a male, Escuinapa, March 25. "Rather common. Appeared in March."

130. **Piranga ludoviciana** (*Wils.*). — Eight specimens, all but one males, Arroyo de Limones, April 16–22. "Common migrant, arrives in April. Numerous at 3000 feet altitude, stragglers seen at 5000 to 6000 feet. Not observed breeding."

131. **Piranga bidentata bidentata** *Swains.* — Ten specimens, Juan Lisiarraga Mt., April 26 and 27. "Migrant, common. Arrives in

April, nests in oaks in May. Not found on lowlands. Iris hazel; feet brownish black" (both sexes). Four of these specimens are adult males, four are females, and two are marked as immature males.

132. **Euphonia elegantissima** (*Bonap.*).—Six specimens (5 males, 1 female), Juan Lisiarraga Mt., May 8–11. "Common. Arrives in April. Feeding on mistletoe berries. Iris hazel. Feet blackish brown" (both sexes). The males are distinctly paler below than a series of five birds from the state of Vera Cruz, but as all but one of the latter are without dates the difference may be seasonal.

133. **Euphonia godmani** *Brewster.*—Seven specimens: Escuinapa, 2 specimens, December 23; Juan Lisiarraga Mt., 5 specimens, April 27 and May 12. Male, Escuinapa, "Not very common. Eyes dark hazel. Feet and legs blackish blue." Juan Lisiarraga Mt., males and female, "Common; pairing. Feeding on mistletoe berries. Iris hazel. Feet brownish black. Bill bluish horn, tip black."

134. **Stelgidopteryx serripennis** (*Aud.*).—One specimen, a male, Escuinapa, March 4.

135. **Iridoprocne albilinea** (*Lawr.*).—Three specimens, all males, Escuinapa, May 23 and 24. "Common. Arrives in April. Iris hazel. Feet brownish black."

136. **Vireo bellii bellii** *Aud.*—One specimen, a female, Escuinapa, March 4. Typical *bellii* in color and measurements. Wing, 55.5; tail, 46.8.

137. **Vireosylva gilva swainsonii** (*Baird*).—Two specimens, Los Pieles (3000 feet), April 18 and 23.

138. **Vireosylva flavoviridis flavoviridis** (*Cassin*).—One specimen, Escuinapa, probably June or July, taken with nest.

139. **Euthlypis lachrymosa tephra** *Ridgw.*—One specimen, a male, Escuinapa, March 17. "Iris hazel. Feet pale blackish brown. Bill brownish black."

140. **Granatellus venustus** *Bonap.*—One specimen, Escuinapa, December 27. This is an immature male, if correctly determined by the collector.

141. **Icteria virens longicauda** (*Lawr.*).—Three specimens, Escuinapa, October 31 and December 26, and Los Pieles, April 15. "Stragglers seen in winter months; not observed breeding." "Upper mandible dark horn, lower mandible bluish white, tip bluish black" (the December specimen). The Los Pieles specimen was "killed in a high tree, feeding on berries." The October specimen, an adult female, had failed to molt two old secondaries of one wing, one of the

other wing, and several feathers of the interscapular region and rump.

142. **Geothlypis trichas occidentalis** *Brewst.* — Two specimens, Escuinapa, December 27. One of these specimens is an immature male and probably represents *G. t. modesta* Nelson. The measurements are: wing, 57.2; tail, 51.6; exposed culmen, 11.4. The other measures: wing, 58.5; tail, 56; exposed culmen, about 11. This specimen appears to be nearer to *occidentalis* than to *arizela*. The western forms of *Geothlypis trichas* are so closely related and there is so much individual and local variation within each subspecies that, unless specimens are perfectly typical, it is impossible to positively identify winter birds. *Occidentalis* being the oldest name for the western Yellowthroats, I have included both these specimens under it.

143. **Oporornis tolmiei** (*Towns.*). — Three specimens, Escuinapa, December 23 and 27, and March 4.

144. **Dendroica nigrescens** (*Towns.*). — Two specimens, Escuinapa, December 20 and January 1.

145. **Dendroica æstiva rubiginosa** (*Pallas*). — Three specimens: a male and a female, Juan Lisiarraga Mt., May 12; and a male, Escuinapa, October 27. "Migrant, arrives in April, rather common. Shot while feeding in high oak trees." These specimens are typical *rubiginosa*, though the May male is perhaps rather large for this form (wing, 64.5).

It is worthy of remark that the winter plumages of male and female *æ. æstiva* closely resemble the nuptial plumages of the corresponding sexes of *rubiginosa*.

146. **Helminthophila celata orestera** (*Oberh.*). — One specimen, marked male, Escuinapa, December 20. Wing, 61; tail, 49. I think there is no doubt of the correct identification of this specimen, for, although not too large for *lutescens*, it is nearer *orestera* in color.

H. c. orestera appears to be a fairly good subspecies. Of seventeen males of *celata* in the collection, eleven measure in length of wing, 57–60, the six others 60.7–61.5. Of twenty-one males of *orestera*, seventeen measure 61.5–63.5, the four others 60–61. The average difference in color is also decided.

147. **Helminthophila celata lutescens** *Ridgw.* — One specimen, apparently a female, Escuinapa, December 24. Wing, 56.5; tail, 44.5. Nearly typical *lutescens* in color.

148. **Rhodinocichla schistacea** *Ridgw.* — Six specimens, Escuinapa, October 14 and 20, December 28–January 30, and March 23. "Not very common. Generally found in pairs or singly in scrub and thick

bushes. Iris hazel." In the March specimen, an adult male, the tarsus is of a most peculiar shape, its front edge being compressed into a narrow ridge almost as sharp as the posterior edge.

The collector's notes on this specimen are as follows: "Iris grayish brown. Feet bluish brown. Upper mandible horn, lower mandible bluish white." The October specimen is a female in juvenal plumage, beginning to acquire the first winter plumage.

149. **Melanotis cærulescens cærulescens** (*Swains.*). — Twelve specimens: Escuinapa, 8 specimens, December 21–January 29 and March 11–18; Juan Lisiarraga Mt., 2 specimens, April 27; Juanna Gomez River, 1 specimen, June 3. "Common. Native name 'Mulato.' Is a fine singer and mocker. Iris hazel. Feet shiny brownish black. Bill brownish black."

150. **Toxostoma bendirei** (*Coues*). — One specimen, Escuinapa, February 12. "Iris brownish yellow. Feet pale reddish brown. Bill dark horn, base of lower mandible nearly white."

151. **Toxostoma curvirostre occidentale** (*Ridgw.*). — Nine specimens: Escuinapa, 8 specimens (2 without dates), October 8–28, December 22–January 21; Juanna Gomez River, 1 specimen, June 1. At the latter locality a "rather common steady resident. Iris light orange."

152. **Mimus polyglottos leucopterus** (*Vig.*). — Eleven specimens: Escuinapa, 10 specimens, October 29, November 4, December 20–27; Jalpa (3000 feet), 1 specimen, April 16. "Iris yellowish pearl. Common steady resident; breeds" (at Escuinapa).

153. **Thryophilus sinaloa sinaloa** *Baird.* — Ten specimens: Escuinapa, 5 specimens, October 2, December 20–January 1, and February 24; Juan Lisiarraga Mt., 2 specimens, May 13; Juanna Gomez River, 3 specimens, June 2 and 4.

"Iris hazel. Feet pale whitish brown. Bill light horn, lower mandible nearly white at base [summer specimens]. Common steady resident. Fine singer."

The October specimen is in very worn plumage, but has begun the postnuptial molt.

The collector states, but apparently on hearsay, that this species "breeds in hollow trees."

154. **Troglodytes aëdon parkmanii** (*Aud.*). — Two specimens, Escuinapa, December 27 and 29. "Rather common."

155. **Pheugopedius felix pallidus** (*Nels.*). — Five specimens: Escuinapa, 4 specimens, October 1, December 24, January 8, and March 24; Juanna Gomez River, 1 specimen, June 1. The October bird is

in juvenal plumage, but has begun to molt into winter dress. The juvenal closely resembles the adult plumage. "Iris hazel. Common steady resident. Shy. Fine singer."

156. **Heleodytes gularis** (*Scl.*). — Five specimens, Juan Lisiarraga Mt., April 30–May 12. "Iris light brown; feet whitish brown. Common steady resident, breeding in hollow trees. Shy. Fine singer."

157. **Sialia sialis azurea** (*Baird.*). — One specimen, a male, Juan Lisiarraga Mt., May 8. "A few stragglers seen. Said to be a winter resident."

158. **Merula tristis tristis** *Swains.* — Nine specimens, Juan Lisiarraga Mt., April 26–May 13. "Iris hazel. Feet blackish brown. Bill medium horn. Common, steady resident, breeding. Has note somewhat like Hermit Thrush."

159. **Merula flavirostris** *Swains.* — Nineteen specimens: Escuinapa, 11 specimens, September 30–October 29, December 20, March 10 and 24; Arroyo de Limones, 5 specimens, April 16–23; Los Pieles, 1 specimen, April 23; Juanna Gomez River, 2 specimens, June 2 and 4. "Iris hazel. Feet pale whitish (or yellowish) brown. Bill brownish yellow, tipped with black. Common. Steady resident. Found in wooded lowlands and mountains to 5000 feet. Breeds in latter part of May and in June. Builds nest of mud, grass, and dead leaves. Song somewhat like that of *Turdus migratorius*."

160. **Hylocichla ustulata ustulata** (*Nutt.*). — Two specimens: Escuinapa, September 13, and Juan Lisiarraga Mt., May 10. At latter locality, "not common."

The May specimen is a typical example of *H. u. œdica* Oberholser, which is of doubtful validity. Comparison of a series from Alameda and El Dorado Counties, California, taken the latter half of May, with a similar series from Westminster, British Columbia, demonstrates that the California birds are undoubtedly slightly paler and less rufescent above, especially on the back, but it is doubtful whether it is desirable to recognize a subspecies on this slight basis.

59. 57, 96 (74.9)

Article XXIII. — AN ANNOTATED LIST OF THE ANTS OF NEW JERSEY.

By William Morton Wheeler.

No State in the Union has been so thoroughly ransacked by collectors of insects as New Jersey. Owing to its geographical position and the diversity of its physical conditions, it has been for years the natural collecting ground for the members of flourishing entomological societies in New York, Brooklyn, Newark, and Philadelphia. And while local collectors, since the time of Rev. G. K. Morris and Mrs. Mary Treat, seem to have given little serious study to the ants, they have nevertheless collected specimens in a more or less desultory manner. Frequently when other more attractive insects are not to be taken, the entomologist, rather than return home empty-handed, will capture a few of the ants which are always to be had in abundance. These specimens accumulate in collections and, when sufficiently numerous and provided with accurate locality labels, eventually come to be of great service in faunistic studies like the one here attempted. I have examined such collections in the possession of Messrs. E. Daecke, Wm. T. Davis, H. L. Viereck, and Prof. John B. Smith, and I wish to express my obligations both to these gentlemen and to Dr. Henry Skinner, through whose kindness I have been able to study specimens in the collections of the Philadelphia Academy of Natural Sciences. All of this material, together with such specimens as I have myself been able to collect on several excursions during the past two years, enables me to record a considerable number of different forms from New Jersey.

This is by no means the first list of New Jersey ants to be published. In his 'Catalogue of Insects found in New Jersey,'[1] Prof. J. B. Smith records 66 species from the State. This list, however, includes the names, apparently derived from incorrectly identified specimens, of a number of European and tropical American ants. When we eliminate these, together with some synonyms and apocryphal names, about 44 legitimate entries remain. For the second edition of this work, entitled 'Insects of New Jersey,'[2] the list of ants was revised and extended by Dr. Wm. H. Ashmead till it comprised

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[1] From the Final Report of the State Geologist of New Jersey. Vol. II, 1890.
[2] Twenty-seventh Annual Report of the State Board of Agriculture, 1899. Trenton, N. J., 1900.

93 forms, the same number I have recorded in the following paper. But a critical examination of this list shows that it must have been compiled very largely from the literature and not from actual specimens, for it still contains a goodly number of synonyms cited as different species and several worthless names from authors like Say and Buckley who were incapable of describing an ant so that it could be recognized with certainty by any future entomologist. When Ashmead's list is revised it is seen to contain 68 valid forms, and only 53 that show evidence of having been actually taken in New Jersey.

Although my list is in all probability incomplete, it nevertheless bears witness to the richness of the ant-fauna of New Jersey in particular and of temperate North America in general. This is evident from a comparison with some of the well-known myrmecologies of Europe. Forel[1] cites 66 different forms from Switzerland, a country somewhat more than twice as large as New Jersey and of even greater physical diversity. From Sweden, which has 22 times the area of New Jersey, Adlerz[2] records only 36 different Formicidæ and from the vast territory of European Russia Nasonov[3] enumerates only 79. And this latter list even includes a number of Mediterranean forms like the species of *Myrmecocystus*, *Messor*, *Pheidole*, *Dolichoderus*, etc.

As a rule ants depend so intimately for their welfare on precise physical conditions that colonies which have not been established by their queens in proper soil, moisture, and sunlight grow slowly and, like plants under similarly unfavorable conditions, take on a more or less depauperate appearance. This is indicated by the small size of both colonies and individuals, and is most noticeable in species that have exceeded the limits of their normal geographical range. Within this range a species is usually confined to a particular station, so that the collector soon learns to associate species with very definite environments. Among our eastern ants we may recognize at least six such stations, each occupied by a series of species which are often so constantly associated with one another as to recall the plant societies of botanists. According to these stations, the New Jersey ants may be grouped as follows:

1. The *woodland*, or *silvicolous fauna*, comprising the species that inhabit our moist, shady forests. With the extinction or drainage

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[1] Les Fourmis de la Suisse. Zurich, 1874.

[2] Myrmecologiska Studier II Svenska Myror och deras Lefnadsförhållanden. Bihang till K. Svenska Vet.-Akad. Handlingar, Band 11, No. 8, 1886.

[3] Contributions to the Natural History of the Ants (Formicariæ). Publications of the Lab. Zool. Mus. Univ. Moscow, Vol. IV, No. 1, 1889, pp. 1–42; i–vi, Tab. i–ix (in Russian).

of these forests or the removal of the undergrowth, this characteristic and in many respects very primitive fauna is rapidly disappearing. It comprises the following forms:

Stigmatomma pallipes,
Proceratium silaceum,
Proceratium crassicorne,
Ponera pennsylvanica,
Myrmecina americana,
Protomognathus americanus,
Stenamma brevicorne,
Aphænogaster fulvum,
Aphænogaster piceum,
Myrmica punctiventris,
Leptothorax longispinosus,
Leptothorax curvispinosus,
Brachymyrmex depilis,
Lasius myops,
Lasius aphidicola,
Lasius speculiventris.

2. The *glade*, or *nemoricolous fauna*, comprising the ants that prefer open sunny woods, clearings, or the borders of woods. This fauna, a portion of which maintains itself even in the gardens and parks of our cities, includes the following:

Solenopsis molesta,
Cremastogaster lineolata,
Cremastogaster lutescens,
Cremastogaster cerasi,
Aphænogaster tennesseense,
Aphænogaster lamellidens,
Aphænogaster aquia,
Leptothorax schaumi,
Leptothorax fortinodis,
Dolichoderus plagiatus and its subspecies and varieties,
Tapinoma sessile,
Prenolepis imparis,
Lasius neoniger,
Lasius interjectus,
Lasius claviger,
Lasius subglaber,
Formica rubicunda,
Formica subintegra,
Formica integra,
Formica difficilis,
Formica exsectoides,
Formica schaufussi,
Formica incerta,
Formica nitidiventris,
Formica fuscata,
Formica subænescens,
Polyergus lucidus,
Camponotus castaneus,
Camponotus americanus,
Camponotus pennsylvanicus,
Camponotus ferrugineus,
Camponotus nearcticus,
Camponotus minutus,
Camponotus subbarbatus.

3. The *field*, or *cæspiticolous fauna*, comprising the ants that prefer to nest in grassy pastures and lawns in situations exposed to the full warmth and light of the sun. To this rather limited fauna belong the following:

Myrmica schencki,
Tetramorium cæspitum,
Lasius brevicornis,
Lasius latipes,
Lasius murphyi.

4. The *meadow*, or *pratincolous fauna*, comprising the following forms, which inhabit low grassy meadows or bogs:

Sysphincta melina,
Sysphincta pergandei,
Cremastogaster pilosa,
Myrmica brevinodis.

5. The *heath*, or *ericeticolous fauna*, includes the ants that inhabit rather poor, sandy, or gravelly soil exposed to the sun and covered with a sparse growth of weeds or grasses. To this fauna belong the following:

Pheidole pilifera,
Pheidole vinelandica,
Myrmica sabuleti,
Prenolepis parvula.

6. The *sand*, or *arenicolous fauna*, comprising the following ants, which prefer to nest in pure sand:

Monomorium minimum,
Pheidole morrisi,
Pheidole davisi,
Aphænogaster treatæ,
Myrmica pinetorum,
Pogonomyrmex badius,
Leptothorax davisi,
Trachymyrmex septentrionalis,
Dolichoderus mariæ,
Dolichoderus gagates,
Tapinoma pruinosum,
Dorymyrmex pyramicus,
Prenolepis testacea,
Prenolepis arenivaga,
Formica pallide-fulva.

A few of our species, like *Lasius americanus* and *Formica subsericea*, are so adaptable that they occur more or less abundantly in all or nearly all of the above stations. Owing to intergradation of these stations in some places, we, of course, have a corresponding mingling of faunas. Thus certain species, like *Monomorium minimum*, seem to belong indifferently either to the heath or sand fauna. In the deserts of the Southwestern States these two faunas may either mingle or be sharply separated from each other. In the Northeastern and Middle States a similar relation obtains between the glade and field faunas which it is often impossible to separate by a hard and fast line. *Formica schaufussi*, for example, seems to occur indifferently in either station.

Family FORMICIDÆ.

Subfamily Ponerinæ.

Stigmatomma *Roger.*

1. **S. pallipes** *Haldeman.*—Gloucester (Fox); Westville (Fox); Lakehurst (Wheeler); Palisades near Fort Lee (Wheeler).

This singular and primitive ant is subterranean and occurs only in rich, rather damp woods, under stones, leaf-mould, or more rarely under or in rotten logs. The colonies are very small, usually comprising less than 20, in extreme cases from 40 to 60 individuals. The males and females appear Aug. 20 to Sept. 17. The larvæ are slender, non-tuberculate, and covered with hair. They are fed by the workers on pieces of insect food, not by regurgitation. The cocoons are elongate, elliptical, dark brown. The ants are very timid and rather slow in their movements. When their nests are disturbed they are at first rather neglectful of their young but eventually return and carry them to a place of safety. For further notes on this ant see my paper: 'The Habits of Ponera and Stigmatomma' (Biol. Bull., Vol. II, No. 1, Nov., 1900, pp. 43–69, 8 figs.).

Sysphincta *Roger.*

2. **S. melina** *Roger.* — This rare ant probably occurs in New Jersey as it has been taken in Pennsylvania. Rev. P. J. Schmitt, O. S. B., found this and the following species under large stones in damp meadows.

3. **S. pergandei** *Roger.* — Like the preceding, and for the same reason, this species probably occurs in New Jersey.

Proceratium *Roger.*

4. **P. silaceum** *Roger.* — As this species has been taken in Pennsylvania by P. J. Schmitt and as I have taken it at Cold Spring Harbor, L. I., there can be little doubt that it occurs in New Jersey. The very small colonies live in rotten wood in damp, shady forests. The workers move slowly and have a habit of resting on their sides. The pupæ are enclosed in delicate cocoons.

5. **P. crassicorne** *Emery.* — There is a single worker of this species from Anglesea, N. J., in the collection of the Philadelphia Academy of Sciences.

Ponera *Latreille.*

6. **P. coarctata pennsylvanica** (*Buckley*) *Emery.* — Camden (Fox); Gloucester (Fox); Anglesea (Viereck); Glassboro (Viereck); Palisades near Fort Lee (Wheeler); Lakehurst (Wheeler); Halifax (Wheeler).

This form, like *Stigmatomma pallipes*, lives in small colonies under stones and vegetable mould and in rotten wood. It prefers rather open woods where there is shade and a fair amount of moisture. The males and winged females may be found in the small, irregularly excavated nests from Aug. 20 to Sept. 10. The larvæ have four pairs of glutinous tubercles on the dorsal surface of the third to sixth abdominal segments. Like the larvæ of *Stigmatomma* they are fed by the workers with fragments of insect food. The pupæ are enclosed in short, elliptical, sulphur yellow cocoons which have a black meconial spot at the posterior pole. When the nests are disturbed the ants are careful of the eggs and larvæ, but more neglectful of the cocoons. Ergatoid females are occasionally found. They have ocelli and larger eyes than the normal workers and a thorax intermediate in structure between that of the worker and the winged female. For further notes on the habits of this interesting species see my paper: 'The Habits of Ponera and Stigmatomma' (Biol. Bull., Vol. II, No. 1, Nov., 1900, pp. 43–69, 8 figs.).

Subfamily MYRMICINÆ.

Myrmecina *Curtis.*

7. **M. graminicola americana** *Emery.* — Riverton (Viereck); Lakehurst (Wheeler).

In the latter locality a single colony of this subspecies was found nesting in the sand in plesiobiosis with a colony of *Myrmica punctiventris* var. *pinetorum* var. nov. Usually *M. americana* nests in rotten wood or under stones in damp shady woods. It is a rare and local species.

Tomognathus *Mayr.*

(Subgen. *Protomognathus* Wheeler).

8. **T. (P.) americanus** *Emery.*—This rare species has been found in Pennsylvania and at Bronxville, New York, so that it can hardly be absent from New Jersey. It lives as a parasite in the colonies of *Leptothorax curvispinosus* Mayr. The female is winged and not ergatoid like the only other known species of the genus (*T. sublævis* Nyl.) of Europe. On this account I have thought it best to create a new subgenus for the American species.

Monomorium *Mayr.*

9. **M. pharaonis** *Linn.* — There can be little doubt that the statement in Dr. Smith's list that this cosmopolitan house ant occurs "throughout the State commonly," is correct. It lives only in houses, warehouses, ships, etc., and has been carried to the different seaports of the globe from its original home in the warmer regions of

the Old World. It is often confounded with our native *Solenopsis molesta* Say but can always be distinguished by its 3-jointed, instead of 2-jointed antennal club.

10. **M. minutum** *Mayr* var. **minimum** (*Buckley*) *Emery.* — Westville (Viereck); Riverton (Viereck); Lakehurst (Wheeler).

This tiny black ant is common in the pine barrens, where it constructs single or closely clustered craters two to three inches in diameter, often about the roots of the plants in the pure sand. The workers forage in files, visiting plants in search of honey-dew and the secretions of extrafloral nectaries. They also eat dead insects with avidity. The colonies in the pine barrens are quite as populous as those of Southern States, like Florida and Texas, where this ant is very abundant.

Solenopsis *Westwood.*

11. **S. molesta** *Say.*—Boonton (Viereck); Fort Lee (Wheeler).

This tiny species is recorded in Smith's list under the name of *S. debilis* Mayr. It is remarkable on account of its great diversity of habits, which exhibit a high degree of adaptability. It is often common in open, grassy places where it may live either in independent formicaries under stones or very rarely in diminutive crater nests, or as a thief-ant in the walls separating the galleries of the formicaries of our larger ants belonging to the genera *Formica*, *Myrmica*, *Stenamma* (*Aphænogaster*), etc. As a free lance it lives on dead insects but when living in cleptobiosis it devours the well-fed larvæ and pupæ of other ants. Under these conditions it escapes unnoticed by its hosts, either on account of its very small size or neutral nest-odor, and takes care to keep its own nests inaccessible to the species on which it preys. In these respects its habits resemble those of the allied European *S. fugax* and *S. texana* of the Southern States. The blackish males and yellow females, which are very much larger than the yellow workers, make their appearance in late August.

S. molesta presents, however, another set of habits on which Prof. Forel has thrown considerable doubt, though, in my opinion, without much justification. Since the settling of the country by man this insect has become a formidable house-ant in certain localities. It was found by Mr. Theo. Pergande in houses in Washington, D. C., and Mr. C. E. Brown has repeatedly taken it in the Milwaukee bakeries. I have myself seen enormous colonies in several residences in Rockford, Illinois, where it lives in the masonry and wood work of kitchens and annoys the house-wife by its assiduous visits to any foods containing fat. It is said not to eat sugar. These facts show that Forel's assertion that Say must have redescribed *Monomorium pharaonis* as *Myrmica molesta* instead of the species afterwards described by Mayr under the name of *Solenopsis debilis* is without foundation.

Still other aspects of this versatile little ant have been described by Prof. S. A. Forbes. I quote from his Seventh Illinois Report[1]: "It [*Solenopsis molesta*] was first found by us June 1–12, 1883, at Normal, Illinois, abundant in many fields of corn, both new and old, and afterwards, May 14–24, 1886, infesting seed corn in the fields at Champaign. In the corn field these ants were usually collected about the kernels in the earth, and frequently more or less hidden in little cavities in the softened grain. May 19, 1887, they were very abundant in a field of corn in sod in Champaign County, eating out the planted kernels. In autumn the same species has been detected by us indulging a similar appetite but in a way to do no harm. Sept. 11–21, 1893, it was found on and within kernels of corn at the tips of ears, which had evidently been injured previously by crickets and grasshoppers. The solid substance of the grains is not actually eaten by these ants, a fact which I demonstrated by dissection of the ants, but it is simply gnawed away, doubtless for the sake of the sweetish and oily fluids of the softened kernels. If plants start from seed thus injured, they are shorter than others adjacent, and have a stunted weak appearance.

"This species has also been several times noticed by us in September in attendance upon the root-louse of corn, *Aphis maidiradicis*, sharing with two other species of ants the cares and benefits of this association. It occurs more frequently, according to our observations, at this season of the year, with the corn-root lice infesting purslane than with those upon the corn itself."

Prof. Forbes's figure and description leave no doubt that the ant he observed was *S. molesta* (=*debilis* Mayr). He calls attention in a previous report to its eating strawberries. This and its corn-eating habits show its relations to the carnivorous and granivorous "fire ant," *S. geminata*, which I have seen eating strawberries and carrying away their seeds on Mr. Kleber's ranch at Corpus Christi, Texas.

Cremastogaster *Lund.*

12. **C. lineolata** *Say.*—Common throughout the State, according to Smith's list. I have seen fine colonies in such widely different

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[1] A Monograph of the Insects Injurious to Indian Corn, 1894.

localities as the Ramapo Mountains near Halifax and the sandy barrens about Lakehurst. In the former locality the ants were nesting under stones, in the latter under the bark of pine logs. There is a vestigial tendency in this ant to construct paper-like partitions in its nest, especially when nesting under stones. The workers have a disagreeable penetrating odor. They ascend trees in files and are much given to attending Aphides and Coccidæ. The males and females are very abundant in the nests at Lakehurst as late as Sept. 24.

13. **C. lineolata** var. **lutescens** *Emery.*—This variety is recorded from New Jersey by Emery (Beiträge, 1894, p. 282), and by Ashmead in Smith's list. I have seen typical specimens from Tinicum, Pa. (Viereck), which is very near the New Jersey boundary.

14. **C. lineolata** var. **cerasi** *Fitch.*—Anglesea, Clementon, and Riverton (Viereck); Medford (Phila. Acad.).

15. **C. lineolata pilosa** *Pergande.*—The types of this subspecies are from the District of Columbia and New Jersey. It is common at Lakehurst, nesting in rotten stumps and logs near or in cranberry bogs. In this locality it exhibits two interesting peculiarities, one of which is as flattering as the other is derogatory to its mental plasticity. Occasionally it constructs from particles of sphagnum moss agglutinated with saliva beautiful little "cow-sheds" over the clustered Coccidæ on the twigs of *Pinus rigida.* These sheds are usually elliptical in shape and about the size of a pecan nut or somewhat larger. They are entered by a little round hole, which is never in such a position as to enable the Coccidæ to escape. More than a dozen of these "cow-sheds" were found on one small pine tree about 6 feet high. Notwithstanding their ability to keep Coccidæ in well-constructed sheds, these ants are killed in great numbers by the pitcher plants (*Sarracenia purpurea*). They creep into the leaves, apparently for the purpose of getting at the water in their hollow bases, but are unable to return over the slanting hairs which point down the throats of the pitchers. In some places hundreds of these ants are found in a decomposing mass in the bottoms of the pitchers and probably constitute a valuable source of food to the plants.

Pheidole *Westwood.*

16. **Ph. pilifera** *Roger.*—Boonton (Viereck); Palisades (Davis); Great Notch (Wheeler); Lakehurst (Wheeler).

The androtypes and gynetypes of this species which, together with workers from Pennsylvania and other States, were described by

Mayr under the name of *Ph. pennsylvanica*, came from New Jersey. It nests in sandy or gravelly soil and usually constructs obscure craters with several openings. More rarely it may be seen nesting under stones. The huge-headed soldiers, which are rarely present in considerable numbers, are very timid and seek the remotest galleries whenever the nests are disturbed. As Morris (Amer. Naturalist, Sept., 1880, pp. 669–670) showed long ago, *Ph. pilifera* is a true harvesting ant, storing the chambers of its nests with seeds of grasses and other herbaceous plants. But like other harvesting species (*Pogonomyrmex* species, *Solenopsis geminata* and several species of *Pheidole* in the Western and Southwestern States) it is also very fond of animal food. I have seen the foraging workers of *pilifera* hurrying to their nests with small insects (Jassids, Aphides, etc.). A marriage flight was witnessed July 27 at Rockford, Ill.

17. **Ph. morrisi** *Forel.* — The types of this species were collected by Morris at Vineland, but it is common in the pine barrens as far north as Lakehurst. It prefers the pure sand and forms low diffuse and often very untidy moundlets sometimes covering one or two square feet and often about the roots of some plant. These nests are very different from the single compact dome-shaped craters in which Forel found this species in North Carolina and in which I have seen it nesting at Jacksonville, Florida, and Montopolis, Texas. The slender yellow workers are extremely active in their movements, the soldiers rather weak and timid. The species is carnivorous. Forel is clearly justified in separating it from *Ph. dentata* Mayr.

18. **Ph. vinelandica** *Forel.* — The types of this species, as the name indicates, came from Vineland, N. J. (Mrs. Mary Treat). It is not uncommon in the pine barrens where the soil contains some clay. The nests are diminutive scattered craters, rarely more than 1–1½ inches in diameter. This species occurs also at North Woodbury (Viereck), and even as far north as Bronxville, N. Y., where I have taken it in a single locality.

19. **Ph. davisi** sp. nov.

Soldier. — Length 3 mm.

Mandibles bidentate at the tip. Head, excluding the mandibles, hardly longer than broad, subquadrate, with slightly convex sides; occipital border deeply excised; upper surface convex, with the occipital groove extending forward to the middle. Eyes about one third the distance from the anterior to the posterior corner. Frontal carinæ short, not half as long as the antennal scape, rapidly subsiding behind. Clypeus short, flattened in front, somewhat convex behind, without a median keel; anterior border rather broadly excised in the middle. Frontal area subtriangular, about as long as broad, with rounded sides and a median carinula. Tips of antennal scapes reaching just beyond the eyes. Pronotum subhemispherical, about half as broad as the head, with prominent but rounded humeri and without a distinct promesonotal constriction. Mesoëpinotal constriction rather deep and broad. Epinotum with two stout spines which are further apart than long, rather blunt at their tips, directed upward and backward and somewhat outward, and each continued anteriorly and posteriorly into a prominent ridge. Epinotal declivity gradually sloping between the spines. Petiole from above somewhat violin-shaped, nearly twice as long as broad. In profile the node is high, with a rather sharp transverse border, long concave anterior, and short abrupt posterior declivity. Postpetiole twice as broad as the petiole and twice as broad as long, with a blunt conule in the middle on either side. Gaster somewhat smaller than the head. Legs with slightly incrassated fusiform femora.

Mandibles shining, with coarse, scattered punctures. Clypeus and frontal area shining; the former irregularly rugulose on the sides. Anterior two thirds of the head sharply longitudinally rugose, posterior third smooth and shining, with a few coarse punctures. Thorax subopaque, punctate-rugose, the rugæ on the pro- and mesonotum somewhat concentric on the sides and sometimes leaving a small smooth area in the middle of the dorsum; mesoëpinotal constriction and epinotal declivity shining, the latter with transverse rugæ. Petiole subopaque, densely punctate; postpetiole smooth and shining, with more opaque, punctate sides. Gaster smooth and shining.

Body and appendages clothed with sparse, rather long, suberect, yellowish hairs.

Head dark brown; mandibles and a broad band across the anterior portion of the head, reddish yellow; apical third of mandibles, petiole, postpetiole, and gaster black; thorax dark brown, mesoëpinotal constriction, epinotal declivity. legs, and antennæ reddish yellow.

Worker. — Length 1.5 — 1.75 mm.

Mandibles multidentate, with the two apical teeth most prominent. Head, excluding the mandibles, a little longer than broad, subquadrate, with slightly convex sides and nearly straight posterior border. Eyes a little in front of the middle of the sides. Clypeus short, convex, with its anterior border excised in the middle. Antennal scapes extending a little beyond the posterior corners of the head. Frontal area very distinct, impressed, rounded behind. Pro- and mesonotum evenly rounded above and on the sides, less convex than in the soldier. Epinotum with the basal and declivous surfaces of equal length, the latter very sloping; spines rather acute, about as long as their distance apart at the base, diverging upward, outward, and backward. Petiole very similar to that of the soldier, but proportionally narrower. Postpetiole a little wider than the petiole, as long as broad, with sides faintly angular in the middle.

Mandibles, head, postpetiole, gaster, and appendages very smooth and shining. Cheeks and front with a few longitudinal rugæ. Mandibles coarsely and sparsely punctate, thorax and petiole opaque, densely and very uniformly punctate.

Hairs on the body and appendages white, suberect, and rather sparse; tapering except on the thorax and pedicel, where they are somewhat enlarged towards their tips.

Mandibles yellow, with dark brown or black teeth; head and gaster black; thorax and pedicel black or very dark brown, with yellowish articulations. Antennæ and legs yellow, the former with the club more or less infuscated, the latter with the middle portions of the femora and tibiæ black.

The types are from Lakehurst. There is also a single soldier from Lucaston (Daecke) in my collection. This ant lives in small colonies in the pure, white sand of the pine barrens and makes small craters somewhat larger than those of *Ph. vinelandica.* It is allied to *Ph. bicarinata* Mayr and *Ph. vinelandica.* The soldier differs from that of *bicarinata* in its smaller size, darker color, shorter head, and more extensive sculpture of the head and thorax. The worker is at once distinguished by the opaque, densely punctate thorax, darker color, and smaller size. The soldier of *davisi* differs from that of *vinelandica* in its much darker color, less deeply emarginate clypeus, shorter head and frontal carinæ; while the differences between the workers of the two species are similar to those between *davisi* and *bicarinata.*

I take pleasure in dedicating this new *Pheidole* to Mr. Wm. T. Davis, the well-known naturalist of Staten Island, who introduced me to the interesting fauna and flora of the pine barrens.

Stenamma *Mayr.*

20. **S. brevicorne** *Mayr.*—I have seen five workers of the large typical form of this rare species from Riverton (Viereck). It nests under stones and dead leaves in rich, shady woods. For further notes on its habits see my paper: 'The North American Ants of the Genus *Stenamma sensu stricto*,' Psyche, Aug., 1903, pp. 164–168.

(Subgenus *Aphænogaster* Mayr.)

21. **S. (A.) tennesseense** *Mayr.*—This species in all probability occurs in New Jersey, since it is known from several localities in Pennsylvania, at least as far east as the Lehigh Water Gap. I have taken it also in Connecticut. It differs from our other species of *Aphænogaster* in having very small and very smooth females with huge epinotal spines. These aberrant females probably establish their colonies in nests of *S. fulvum*, in the same way that *Formica difficilis* var. *consocians* establishes its colonies in nests of *F. schaufussi* var. *incerta* (*vide infra*). At least *tennesseense* is known to occur only in regions where *fulvum* is unusually abundant, and several mixed colonies of the two species, containing queens of *tennesseense* only, have been recorded.

22. **S. (A.) treatæ** *Forel.* — The types of this species, which is readily recognized by the remarkable lobe on the base of the antennal scape in the worker and female, were taken by Mrs. Mary Treat at Vineland. I have seen many colonies in the pine barrens about Lakehurst. The nests, which are not readily found, except by following foraging workers, are in the sand in the shade of the oaks and pines. The entrance is sometimes produced upwards in the form of a little chimney and the earth or sand pellets removed by the ants while excavating the galleries are scattered about over a circular area 8 to 10 inches in diameter. The workers are very cowardly.

23. **S. (A.) lamellidens** *Mayr.* — A few colonies, found at Lakehurst, were nesting like the preceding species in rather shady places. Two isolated females were discovered in the act of establishing their formicaries in little cells about 3 inches below the surface of the sand. In one of these incipient nests there were a few larvæ and pupæ, in the other a few diminutive workers.

24. **S. (A.) fulvum** *Roger.* — Recorded from Caldwell (Cresson). I have always taken this the typical form of the species in rotten wood in rather dense forests. It is much less common than the following subspecies and variety.

25. **S. (A.) fulvum aquia** (*Buckley*) *Emery.* — Anglesea (Viereck); Clementon (Viereck); Westville (Phila. Acad.); Jamesburg (Davis); Halifax (Wheeler).

This form occurs under stones in shady woods, often in the same stations as the following variety.

26. **S. (A.) fulvum aquia** var. **piceum** *Emery.* — Very common in shady woods along the Palisades; also in the Ramapo Mountains, about Halifax. Careful studies of the habits of this ant have been recently published by Miss Adele M. Fielde in a series of papers.[1]

Myrmica *Latreille.*

27. **M. punctiventris** *Roger.* — Camden (Smith's List); Riverton (Viereck); Medford (Phila. Acad.); Fort Lee (Wheeler).

The worker of the typical form of this species is dark colored and has apically deflected epinotal spines which are longer than the epinotal declivity. The sculpture of the head, thorax, and pedicel is very coarse. The species, which is by no means common, nests in small colonies under stones in moist, shady woods. The males and winged females make their appearance during late August and early September.

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[1] A Study of an Ant. Proc. Acad. Nat. Sci. Phila., Vol. LIII, 1901, pp. 425–449; Further Study of an Ant, *ibid.*, Vol. LIII, 1901, pp. 521–544; Power of Recognition among Ants, Biol. Bull., Vol. VII, 1904, pp. 227–250, etc.

28. **M. punctiventris pinetorum** subsp. nov.

The workers and females of this form are smaller, much paler in color and much less heavily sculptured than the corresponding phases of the typical species. The epinotal spines are shorter than the epinotal declivity and not deflected at their tips.

A single colony found nesting in pure sand in the pine barrens at Lakehurst.

29. **M. rubra brevinodis** *Emery.* — The *M. sulcinodis* Nyl. recorded by Mayr from New Jersey is probably *brevinodis* or its var. *sulcinodoides* Emery, which should occur in the State.

30. **M. rubra scabrinodis** *Nyl.* var. **sabuleti** *Meinert.* — New Jersey (Emery); Fort Lee (Wheeler).

This variety of the palæarctic *M. rubra scabrinodis* is reddish in color and in the male phase has a very long antennal scape which is somewhat more than a third the length of the funiculus. It nests in sandy or gravelly sunny places such as open pastures, road-sides, etc.

31. **M. rubra scabrinodis** *Nyl* var. **schencki** *Emery.* — New Jersey (Emery); New Brunswick (J. B. Smith); Lahaway (J. B. Smith); Lakehurst (Wheeler).

This form is cited in Smith's List under the name of the European form, *M. lobicornis.* The male has short, thick antennal scapes which are shorter than those of *sabuleti*, being rarely longer than one fourth of the funiculus.

Pogonomyrmex *Mayr.*

32. **P. badius** *Latreille.* — This ant, the "Florida harvester," is recorded in Smith's List as occurring at Caldwell (*teste* Cresson). This is certainly very far north but is not impossible as several Floridian insects have been taken in New Jersey.

P. badius is abundant in the vicinity of Jacksonville, Fla., where I have made a few observations on its habits. Its nests are flat circular craters, 5–10 inches in diameter, with a central perpendicular or somewhat inclined entrance and usually a lot of chaff about the rim. This chaff is stripped from the stored seeds by the workers. There is no circlet of living grass about the periphery of the craters, which may be single or in groups and resemble those of *P. comanche* in the sandy post-oak woods of Texas. The Florida species is peculiar in having polymorphic workers. The big-headed major workers, or soldiers seem to be no more vicious than the small and intermediate forms. Smaller nests contain very few or none of the big-headed individuals, which naturally increase in number with the growth of the colony.

Leptothorax *Mayr.*

33. **L. longispinosus** *Roger.* — This species is recorded from New Jersey by Emery. I have taken it in the woods about Fort Lee. It nests under small stones lying on large boulders, in the clefts of rocks, in stone walls, and more rarely under bark. It seeks its food on the low vegetation in the shade of the trees.

34. **L. curvispinosus** *Mayr.* — Clementon (Viereck); Riverton (Viereck); Lakehurst (Wheeler and Davis); Fort Lee (Wheeler).

This species usually nests in hollow twigs of the elder in shady woods. Two fine colonies were found at Lakehurst in oak-galls (*Amphibolips ilicifoliæ* Bassett and *A. confluentus* Harr.).

35. **L. schaumi** *Roger.* — There can be little doubt that this species occurs in New Jersey as it is known to occur in Pennsylvania and has been found near New York City. I have seen it nesting in the bark of large elms and willows.

36. **L. fortinodis** *Mayr.* — A small colony of this species was found at Lakehurst nesting in the bark of a living pitch-pine (*Pinus rigida*).

37. **L. texanus davisi** subsp. nov.

The worker of this form differs from that of the typical *texanus*, all three phases of which I described from Milano, Texas,[1] in the much less rugose surface of the head, thorax, and pedicel. This is especially noticeable on the thoracic dorsum, petiole, and postpetiole, where, instead of the deep reticulate rugosity of the typical form, the surface is finely and evenly reticulate and therefore much more shining. Corresponding differences are observable between the females of the two forms. The female *davisi* has the upper surfaces of the petiole and postpetiole shining though rugose. The epinotal spines are also longer and more robust than in the typical *texanus*.

Described from several workers and a deälated female taken at Lakehurst. Like the Texan form, *davisi* nests in pure white sand, forming slender galleries a few inches in length. It moves about rather slowly on the sunlit surface of the sand in search of small insects.

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[1] Proc. Phil. Acad. Nat. Sci., 1903, pp. 245–247.

Tetramorium *Mayr.*

38. **T. cæspitum** *Linn.* — Camden Co. (Daecke).—I have seen this species, the "lawn ant," only at Fort Lee. It is evidently imported from Europe and seems to be making but slow progress over the country. It occurs northward and eastward of New York as far as the Connecticut boundary, westward as far as Philadelphia, and southward as far as Virginia. Emery mentions its occurrence also in Tennessee and Nebraska, but I have never been able to find it in the Middle West.

Strumigenys *F. Smith.*

39. **S. pergandei** *Emery.* — This and the two following species are known to occur in Pennsylvania, and will doubtless be found also in New Jersey. They are all very rare ants and nest in the ground, often in plesiobiosis with larger species (*Formica*, etc.).

40. **S. pulchella** *Emery.*

41. **S. clypeata** *Roger.*

Atta *Fabricius.*

(Subgenus *Trachymyrmex* Forel.)

42. **A. (T.) septentrionalis** *McCook* (= ? *tardigrada* Buckley). — Vineland (Mrs. M. Treat, McCook); Toms River (Morris); Lakehurst (Wheeler).

This species, called the "northern cutting ant" by McCook, is the only one of the North American *Attii*, or fungus-growing ants, whose range extends into the Northern States. It is abundant in the pine barrens about Lakehurst, nesting in pure white sand. It moves very slowly and is so timid that it retreats into its nest at the slightest alarm. The nest is not easily found except during the spring and autumn when the ants are actively excavating. At such times one may find a circular nest-entrance about three sixteenths of an inch in diameter and an inch or two to one side of it a pile of sand brought out by the workers. The entrance leads into an oblique gallery which widens at intervals into two or three spheroidal chambers varying from 1–2 inches in diameter. Sometimes these chambers form the blind terminations of two or three different galleries branching off from the main or entrance gallery. The rootlets of plants are left spanning the chambers and from these fibrous supports the fungus gardens are suspended. They consist of a substratum of bits of leaves, buds, green seeds, and caterpillar excrement collected by the ants and woven together by the white hyphæ of a mould-like fungus, which is carefully cultivated by the insects and constitutes their only food. Since the culture of the fungus depends on definite degrees of moisture and temperature the ants are very careful of the ventilation of their nest. During the dry spells of midsummer the entrance is closed with bits of leaves and twigs to prevent the escape of the requisite humidity. At such times it is almost impossible to find the nests. In spring, however, when, after the first warm rains, the ants are clearing and renovating their chambers, and again in the fall after they have raised their brood and are preparing for the winter, the external architecture of the nest is more noticeable. The colonies of *A. septentrionalis* in New Jersey are feebler than those which I have seen near Miami, Florida, and near Austin, Texas. This somewhat depauperate character is evidently the result of unfavorable conditions at the extreme edge of the range of the species, which can hardly extend further north than the pine barrens.

Subfamily Dolichoderinæ.

Dolichoderus *Lund.*

43. **D. mariæ** *Forel.*—Vineland (Mrs. Mary Treat); Manumuskin (Daecke); Clementon (Viereck); Lakehurst (Davis and Wheeler).

This ant is one of the most beautiful insects of the pine barrens, where it nests in the pure sand in colonies comprising thousands of individuals. The nests are frequently excavated about the roots of grass (*Andropogon scoparius*) or turkey-beard (*Xerophyllum setifolium*). The workers remove nearly every particle of sand from the roots and dig a pot-shaped cavity from 12–18 inches in depth and 3–5 inches in diameter. The spaces between the root-fibers serve as galleries and in them the larvæ and pupæ are kept. The withdrawal of so much sand from the roots of the grass often destroys the vigor of the plant and prevents it from flowering. Bits of dead leaves, pine-needles, etc., are heaped over the surface between the grass blades, sometimes in sufficient quantity to form a flat mound, but quite as often the top of the nest is concave, owing to the withdrawal of the sand and its being only partially replaced by vegetable débris. The nests are most easily located by first finding the workers on the foliage of the oaks and pines, where they attend plant-lice and mealy-bugs, and thence tracing them as they move homeward in uninterrupted files often over considerable distances (30–50 ft.). It is probable that the number of plant-lice and mealy-bugs within a radius that can be conveniently patrolled by a single colony of *mariæ* is far from sufficient to supply its thousands of workers with food. Hence the colonies must from time to time move to new localities and establish fresh nests. This is easily accomplished owing to the ease and rapidity with which the sand can be excavated by a populous colony. *D. mariæ* is a pugnacious ant and when disturbed emits from its anal gland a peculiar volatile, smoky excretion which is unlike that of our other *Dolichoderine* genera (*Tapinoma*, *Dorymyrmex*). The males and winged females are found in the nests during the latter part of August. For additional notes on this and the following *Dolichoderi* see my paper: 'The North American Ants of the Genus Dolichoderus,' Bull. Am. Mus. Nat. Hist., Vol. XXI, 1905, pp. 305–319.

44. **D. mariæ davisi** *Wheeler.* — Jamesburg (Davis).

The worker differs from that of the typical form in having erect hairs on the head and thorax, which are also of a somewhat browner color. Only the base of the first gastric segment is yellow and the lateral spots on the second are barely indicated.

45. **D. taschenbergi** *Mayr* var. **gagates** *Wheeler.* — Iona (Daecke); Jamesburg (Davis); Clementon (Viereck); Lakehurst (Davis and Wheeler).

This form is as common in the pine barrens as *D. mariæ* and has very similar habits.

46. **D. plagiatus** *Mayr.* — Iona (Daecke); Jamesburg (Davis); Riverton (Viereck); Lakehurst (Wheeler).

Like *D. mariæ* and *gagates*, this species nests in the ground and attends Aphides on the leaves of trees and bushes. Its colonies are very small.

47. **D. plagiatus** var. **inornatus** *Wheeler.*—This variety, which occurs at Lakehurst, differs from the typical form in lacking the yellowish spots on the gaster.

48. **D. plagiatus pustulatus** *Mayr.*—This variety occurs at Lakehurst. It differs from the typical *plagiatus* in having the head and thorax more shining and less deeply foveolate.

49. **D. plagiatus pustulatus** var. **beutenmuelleri** *Wheeler.* — This variety occurs at Lakehurst. It differs from the typical *pustulatus* in the same way as the variety *inornatus* differs from the typical *plagiatus*, namely in lacking the yellowish spots on the gaster.

Tapinoma *Förster.*

50. **T. sessile** *Say.*—Camden Co. (Fox); Caldwell (Cresson); Clementon (Viereck); Cape May (Phila. Acad.); Fort Lee, Halifax, Lakehurst (Wheeler).

Probably very common throughout the State. It nests under stones, dead leaves, logs, bark, etc., usually in sunny places. The larvæ and pupæ are salmon colored. The workers emit a peculiar rancid-butter odor, the characteristic "Tapinoma odor," also observed in the two following species.

51. **T. pruinosum** *Roger.* — Atco (Viereck); Halifax (Wheeler); Lakehurst (Wheeler).

The occurrence of this species as far north as New Jersey has been overlooked hitherto. It is readily distinguished from *T. sessile* by its smaller size, paler color, and silvery or frosty appearance. At Lakehurst, it nests in pure, white sand, forming single or clustered craters somewhat like those of *Monomorium minutum.* I have also seen a colony nesting under a stone at Halifax and another near Ramapo in the Ramapo Mountains.

Dorymyrmex *Mayr.*

52. **D. pyramicus** *Roger.* — South Jersey (Smith's List); Lakehurst (Wheeler).

A few colonies belonging to a dark variety of this southern species, near var. *niger* Pergande, were seen nesting in the white sand at Lakehurst. It is probable that the species is really common in the southern portion of the State as claimed in Smith's List. The nest is a small regular crater 3 or 4 inches in diameter.

Subfamily CAMPONOTINÆ.

Brachymyrmex *Mayr.*

53. **B. heeri depilis** *Emery.*—Great Notch (Wheeler); Fort Lee (Wheeler).

This tiny ant is found nesting under stones in shady woods. The workers seem to be subterranean in their habits, rarely or never coming to the surface, at least during the daytime. They resemble the yellow species of *Lasius* in their habit of cultivating root-coccids in their subterranean galleries and chambers. The pupæ are not nude, like those of the following genus, but enclosed in cocoons. The males and relatively large females make their appearance in late August.

Prenolepis *Mayr.*

54. **P. imparis** (*Say*) *Emery.* — Caldwell (Cresson); Camden Co. (Fox); Halifax (Wheeler).

This is the largest and most widely distributed of the North American species of the genus. It prefers to nest in shady oak woods in soil containing more or less clay. It is almost never found nesting under stones but forms small circular craters consisting of earthen pellets. The workers visit trees for the purpose of feeding on the excretions of the extrafloral nectaries. I have seen them eagerly licking these organs on the leaves of *Ailanthus glandulosus.* After imbibing these liquids the gaster often becomes so distended that it is four or five times its normal size and the elegant gait of the insect becomes an awkward waddle. In this replete condition the *P. imparis* worker may be said to represent a temporary stage of the more extraordinary development of the gaster seen in the honey-ants (*Myrmecocystus*). The males and females of *P. imparis* often pass the winter in the parental nest and celebrate their nuptial flight in the spring.

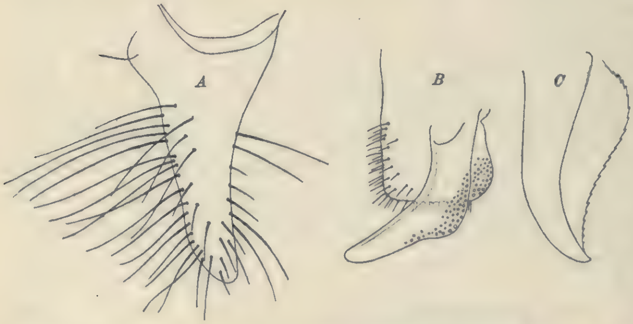

Fig. 1.—A outer, B median, and C inner genital valve of male *Prenolepis imparis* Say.

55. **P. imparis** var. **testacea** *Emery.* — Clementon (Viereck); Medford (Viereck); Lakehurst (Davis and Wheeler).

A pale variety which nests only in sandy regions and on this account is the only form of the species to be found in localities like the pine barrens. It is exceedingly common at Lakehurst but seems to be somewhat nocturnal in its habits. Once only during the daytime have I seen the workers leaving the nest in a file to visit some Aphides on a neighboring oak. They readily assume the replete condition, and owing to their yellowish color resemble the honey-ants even more closely than do the workers of the typical form.

56. **P. parvula** *Mayr.* — Atco (Viereck); Clementon (Viereck);

Brown's Hill Junction (Daecke); Halifax (Wheeler); Lakehurst (Wheeler).

This tiny species is not uncommon under stones in gravelly and sunny places. At Lakehurst it prefers to nest under the great patches of moss and lichen that spread over the sand in the dry woods. In this species, too, the males and winged females pass the winter in the parental nest and take their nuptial flight in the early spring.

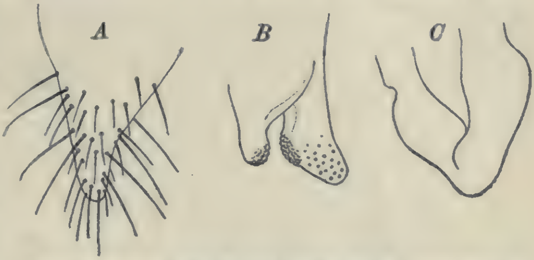

Fig. 2.—A outer, B median, and C inner genital valve of male *Prenolepis parvula* Mayr.

57. **P. arenivaga** sp. nov.

Worker. — Length, 2–2.5 mm.

Mandibles with oblique blades, 6–7 toothed, third and fifth tooth from the apex smaller than the others. Clypeus convex, carinate, with the anterior border faintly and sinuately excised in the middle. Head, including the mandibles, distinctly longer than broad, not narrower in front than behind, cheeks rather convex; occipital border very faintly excised. Antennæ slender; scape surpassing the posterior corner of the head by at least two fifths of its length. Funicular joints twice as long as broad, except the second to fourth, which are a little longer than broad. Thorax robust, mesoëpinotal depression pronounced, its floor somewhat longer than the transverse distance between the two metathoracic stigmata. Petiole small and narrow, cuneate in profile, inclined forward, its ventral surface slightly convex; its upper border blunt in profile, rounded when seen from behind. Gaster and legs of the usual structure.

Surface of body smooth and shining, antennæ and legs somewhat more opaque.

Body covered with very minute white pubescence which is dense on the antennæ and legs but sparse on the body. Antennal scapes, femora, tibiæ, and body with tapering erect or suberect hairs which have dark brown or black bases and white tips. These hairs are very conspicuous on the upper surface of the head, thorax, and gaster.

Pale yellow throughout, mandibular teeth and eyes black.

Male. — Length, 1.8–2 mm.

Mandibles well-developed but edentulous. Clypeus and head, except for the ocelli and more prominent eyes, in shape somewhat like that of the worker. Antennæ slender; scape extending nearly half its length beyond the posterior corner of the head. Mesonotum broad and convex anteriorly, but depressed just in front of the convex scutellum. Epinotum in profile rather sloping, with a but faintly indicated angle between its longer basal and shorter declivous surfaces. Petiole like that of the worker. Genital appendages all long and slender, outer pair triangular, nearly three times as long as broad at the base, tapering to a rounded tip; the bifurcated median pair are slender, digitiform, with the papillose surfaces at the tip; the inner pair are simple and triangular, with tapering rounded tips. Legs long and slender.

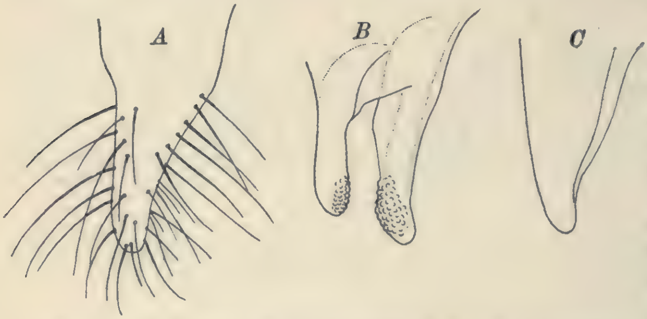

Fig. 3.—A outer, B median, and C inner genital valve of male *Prenolepis arenivaga* sp. nov.

Shining; the head and thorax a little more opaque than the gaster as their surfaces are somewhat shagreened. Appendages subopaque.

Pile and pubescence similar to those of the worker. Hairs on the outer genital appendages rather feeble.

Dark brown, gaster nearly black. Mouth parts, articulations of legs, wing-insertions, antennal funiculi, and genital appendages yellow or pale brown. Wings uniformly grayish hyaline, with very pale veins.

Described from several specimens taken in the pine barrens at Lakehurst, Sept. 25, 1904. This species occurs also in the sandy post-oak woods at Delvalle and Montopolis near Austin, Texas. In all these localities it lives in the pure sand and makes the same kind of nests, namely, flat craters about 1½ to 2 inches in diameter with a small central entrance. At Lakehurst the ants live in the pure white sand overlying a layer of ochre yellow sand. As they dig down into the latter the craters contrast in color with the surrounding white surface.

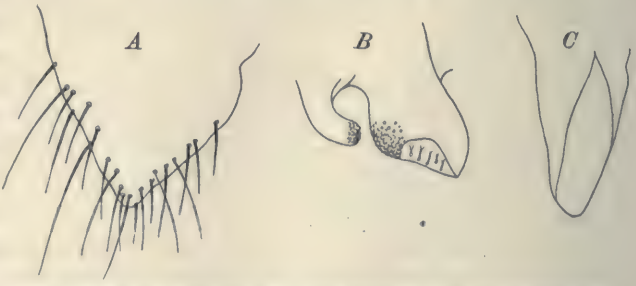

Fig. 4.—A outer, B median, and C inner genital valve of male *Prenolepis guatemalensis* Forel.

Although the worker of *P. avenivaga* resembles that of *P. guatemalensis* in its pale yellow color, the former species is nevertheless clearly distinct as shown by the genital valves of the male. For the sake of comparison I figure the valves of *guatemalensis* (Fig. 4) and of the three species enumerated from New Jersey (Figs. 1 to 3). The valves of two other North American species (*P. bruesi* Wheeler and *P. melanderi* Wheeler) are given in Psyche (June, 1903, pp. 104 and 107), and Emery (Beiträge, etc., 1893, pl. xxii, Fig. 24) has figured the outer genital valves of *P. fulva* Mayr.

Lasius *Fabr.*

58. **L. niger** *Linn.* var. **americanus** *Emery.*— Camden, Riverton, and Anglesea (Viereck); Cape May (Phila. Acad.); Jamesburg (Davis); Halifax, Lakehurst, and Fort Lee (Wheeler).

This form passes in much of our entomological literature as *L. alienus*, although Emery has given reasons for regarding it as distinct from the European form. It is not only the commonest of our numerous species of *Lasius* but the most abundant of our ants, and hence of all our insects. It occurs over the whole of North America except the extreme southern and southwestern portions, from timberline on the highest mountains to the sands of the seashore. Even in circumscribed localities it shows in its nesting sites great adaptability to different physical conditions, from the damp rotten wood of dense forests to the sandy soil of dry, sunny roads. Usually the workers living in the latter stations are much paler in color than the woodland forms and might be regarded as representing a distinct variety. The nests are indifferently under bark, logs, or stones, in rotten wood or in the soil. When in soil they are surmounted by small single or clustered craters. Like all of our other species of the genus, *L. niger* var. *americanus* is much given to cultivating root-coccids and root-aphids in the chambers and galleries of its nests, but, with the exception of the var. *neoniger*, it is the only one of our forms that is not exclusively subterranean in its habits. It may often be seen visiting the foliage of trees and bushes in search of Aphides and small insects. Prof. A. S. Forbes[1] has shown that this insect is of considerable economic importance on account of its noxious habit of cultivating the root-aphids of maize, or Indian corn (*Aphis maidiradicis*). His observations are well worth quoting, as they throw light not only on the habits of this and our other species of *Lasius* but also of other aphicolous ants:

"Seven kinds of ants have been found by us fulfilling the reaction of host, guardian, and nurse to the corn root aphis; viz., *Formica fusca*, *Formica schaufussi*, *Lasius niger*, *Lasius niger alienus*, *Lasius interjectus*, *Myrmica scabrinodis*, and *Solenopsis debilis*. The occurrence in this relation of all but the third and fourth just mentioned is, however, so rare that they need receive here no more than this passing mention, especially as their services to the aphis are, so far as observed, the same in character and value as those of the much more abundant species."

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[1] A Monograph of Insect Injuries to Indian Corn. Part I. Trans. Dep. Agr. Ill., Springfield, 1894.

The following notes are given on the life-history, haunts, actions, and habits of the ant:

"The winged sexual forms, male and female, of this ant begin to appear each year, as early as the latter part of June (the 21st to the 27th), hatching from pupæ which may have formed late in May (27th and 28th, by our notes). The emergence of males and females from the pupæ continues throughout the season, certainly into October and probably to November, but the males perish before the winter. The females, however, having been fertilized and deprived of their wings, begin their separate excavations in fall, or continue with the workers in nests already established. There they hibernate, sometimes, at least, commencing to lay their eggs in fall and living in spring through April and May.

"The nests or burrows of this ant, in which these breeding operations are carried forward, are widely distributed in corn fields and grass lands,— especially in the latter, along the borders of roads and paths, — and also under stones and boards, in and under decaying logs, and in an indefinite variety of situations. In corn fields they are established almost wholly in the hills of corn, and remain here among the old corn roots throughout the season. As this is the commonest and most generally distributed of all our ants in Illinois, an exhaustive list of its places of habitation would have little present interest. It has never been found by us to form large settlements, or making mounds or conspicuous structures of any kind; but simply scattering its little burrows almost indiscriminately, living in small families rather than great colonies or city-like aggregations, and piling up only a small temporary heap of pellets around the mouth of its burrow. When its mines are explored they are found to consist of irregularly radiating and connected tunnels, rarely going to a greater depth than six or eight inches, or extending outward over a horizontal area of more than twelve or fifteen inches. Here and there in their course and at their extremities and at various depths are chamber-like enlargements in which their eggs and young and the eggs of the corn root aphis are preserved and cared for. Here also considerable collections of the worker ants are usually found, — especially in winter and in times of summer drouth, — and in these chambers the female resides and lays her eggs. . . .

"The fact has already been mentioned in this paper that the sexual egg-laying generation of the corn root aphis — the last to appear in fall — is born in the galleries of the nests or homes of the ants, and that here the sexes pair and the females drop their eggs. As one explores these nests in November, when the root louse eggs are being laid, he is struck with the relative independence of these oviparous adults, which are allowed to wander unattended through the burrows of their hosts as far as a foot or more from a corn root. We have found them, however, still feeding as late as November 5, and laying eggs November 21. These eggs, which are yellow when first deposited, but soon become shining black, and turn green just before hatching, are at first scattered here and there, as it happens, but are finally gathered by the ants for the winter in little heaps and stored in their galleries, or sometimes in chambers made by widening the galleries as if for storage purposes. If a nest is disturbed, the ants will commonly seize the aphis eggs — often several at a grasp — and carry them away. In winter they are taken to the deepest parts of the nest (six or seven inches below the surface in some cases observed) as if for some partial protection against frost; but on bright days in spring they are brought up, sometimes within half an inch or less of the surface, sometimes even scattered about in the sunshine, and carried back again at night—a practice probably to be understood as a means of hastening their hatching. I have repeatedly seen these ants in confinement with a little mass of aphis eggs, turn the eggs about one by one with their mandibles, licking each carefully at the same time as if to clean the surface. These anxious cares are of course explained by the use the ants make of the root lice, whose excreted fluids they lap up greedily as soon as the young lice begin to feed. They are not, however, wholly dependent on this food supply, at least in early spring, as I have seen them kill and drag away at that season soft-bodied insect larvæ, doubtless to suck their juices out as food. . . .

"That the young of the first generation are helped by the ants to a favorable position on the roots of the plants they infest is quite beyond question. It is shown (1) by the fact that in many cases the aphis could not get access to such roots unless these had been previously laid bare by the tunneling of the ants, and (2) by the behavior of ants with mines already constructed, when the root aphis is offered to them. We have repeatedly performed the experiment of starting colonies of ants on hills of corn in the insectary and exposing root lice from the field to their attentions, and in every such instance, if the colony was well established, the helpless insects have been seized by the ants, often almost instantly, and conveyed underground, where we would later find them feeding and breeding on the roots of the corn. In many cases in the field, we have found the young root aphis on sprouting weeds (especially pigeon-grass), which have been sought out by the ants before the leaves had shown above the ground; and, similarly, when the field is planted to corn, these ardent explorers will frequently discover the sprouting kernel in the earth, and mine along the starting stem and place the plant lice upon it. . . .

"I need hardly say that the relations above described between the corn root aphis and these ants continue without cessation throughout the year, the succeeding generations being quite as useful to the ants as those whose history I have thought it worth while to follow in detail. In order to determine more precisely the value of the services performed by their guardians, I arranged in several years a series of experiments designed to show to what extent the plant lice could help themselves if left unattended. Owing to the waywardness of the ants, which in most cases refused to content themselves in confinement, but one of these experiments came to a successful issue. April 13, 1889, corn root aphis eggs were placed in the earth among smart-weed roots to test the ability of the young lice hatching to find the roots for themselves. A check experiment was started at the same time with eggs placed in artificial cavities beside smart-weed roots. April 25 no insects could be found on the plants of the first experiment, while the cavities made in the second experiment contained young lice upon the roots in fine condition."

59. **L. niger** var. **neoniger** *Emery.*—This variety is characterized by having erect hairs on the legs and antennal scapes. It is much less abundant than the preceding and seems to have a northern or subboreal distribution. A few specimens from Anglesea (Viereck) and Hewitt (Davis) belong to this variety.

60. **L. brevicornis** *Emery.*—I have taken this species at Fort Lee, Halifax, Lakehurst, and near the Great Notch. It nests under stones, on hill slopes and in pastures, in rather small colonies, cultivates root-aphids, and, so far as I have been able to observe, is strictly subterranean like all of the remaining species of *Lasius* recorded in this list. The workers have a faintly pungent odor.

61. **L. myops** *Forel.*—Great Notch (Wheeler); Halifax (Wheeler).

This is the American representative of the European *L. flavus*, under which name it is sometimes recorded in the literature. The bodies of the workers have a milky white appearance. According to my observations this ant always occupies a definite station, preferring to nest under stones, or leaf-mould in damp, shady woods. The colonies are rather small. The males and winged females may be found in the nests during the first week of August.

62. **L. umbratus mixtus** *Nyl.* var. **aphidicola** *Walsh.*—Caldwell (Emery); Woodbury (Viereck); Fort Lee (Wheeler); Great Notch (Wheeler).

This ant forms much larger colonies than the preceding species. It prefers damp, shady woods and in the Eastern States nests under large stones and in and about old logs and stumps. In the Middle West (Wisconsin and Illinois) it often builds considerable mounds of earth (1–5 ft. in diameter and ½–1 ft. high) around or over decayed stumps. These mounds are perforated with numerous openings and shot through with living grass blades. During winter and early spring, but especially during the latter season, the nests teem with snow-white Aphides and coccids which are cared for by the ants. The males and winged females appear Aug. 2–11.

63. **L. umbratus mixtus** var. **affinis** *Schenck.*—This European variety is recorded by Mayr from New Jersey. I have not yet been able to recognize it among any of my specimens collected in the United States.

64. **L. umbratus minutus** *Emery.*—This subspecies was described by Emery from specimens collected in New Jersey and Maine. In my collection there are three workers marked New Jersey, received from Mr. Pergande.

65. **L. speculiventris** *Emery.*—The types of this species are from Caldwell. I have taken it at Fort Lee and Great Notch. The colonies are very large, like those of *L. aphidicola*, and are found under stones or rotten logs in rich, shady woods. A populous colony found in the early spring at Fort Lee in a pine stump contained thousands of snow-white Aphides of all ages. The females of this species are unknown.

(Subgenus *Acanthomyops* Mayr.)

66. **L. (A.) interjectus** *Mayr.*—Caldwell (Cresson); Lakehurst (Wheeler).

The yellow *Lasii* of the subgenus *Acanthomyops* besides having only

3- instead of 6-jointed maxillary palpi in the worker and female phases, have a peculiar and rather agreeable odor like oil of citronella, quite unlike the odor of the typical *Lasii*. They all form large colonies and lead a subterranean, aphidicolous existence. *L. interjectus* is the largest species of the genus. It is found nesting in old logs and stumps in open woods and occasionally makes rough mounds or merely excavates its galleries under large stones. The mound nests, like those of *L. aphidicola*, often attain considerable dimensions in Wisconsin and Illinois where *interjectus* seems to be more abundant than in the Eastern States.

67. **L. (A.) claviger** *Roger.* — Caldwell (Cresson); Camden Co. (Smith); Merchantville (Daecke); Riverton (Viereck); Fort Lee, Lakehurst, and Halifax (Wheeler).

This is the commonest of our species of *Acanthomyops*. It nests under stones along the edges of woods where there is plenty of warmth and moisture. The males and winged females may be found in the nest as early as Aug. 25, though the nuptial flight may not occur till a month later.

68. **L. (A.) claviger subglaber** *Emery.* — As this subspecies is found near New York City I believe there can be no doubt of its occurrence on the western bank of the Hudson. It may be distinguished from the typical *claviger* in all three phases by its somewhat smaller size. The hairs on the gaster and thorax of the female are shorter and less abundant than in the type.

69. **L. (A.) latipes** *Walsh.*— Camden (Smith); Weymouth (Daecke); Fort Lee (Wheeler).

This species is rather common in grassy fields under large stones. Mr. J. F. McClendon and myself have shown[1] that some colonies have two kinds of females. One of these (the β-female) is very hairy, has much flattened femora and tibiæ, and the hind tarsus is shorter than the hind tibia. The other (α-female) is intermediate in structure between the β-female and the female of *L. claviger*.

70. **L. (A.) murphyi** *Forel.* — There can be little doubt that this interesting species, hitherto known only from North Carolina, occurs in New Jersey. In the Angus collection of the American Museum of Natural History there are a number of specimens of all three phases collected at West Farms, which is now a part of Greater New York, and I have taken females, that had just descended from their nuptial flights, at Cold Spring Harbor, Long Island, and at Mount Kisco, New York.

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[1] Dimorphic Queens in an American Ant (*Lasius latipes* Walsh). Biol. Bull., Vol. iv, pp. 149–163, 3 figs.

Formica *Linn.*

71. **F. sanguinea rubicunda** *Emery.*— Delaware Water Gap (Viereck); Woodbury (Phila. Acad.).

This subspecies of the holarctic blood-red slave-maker, or sanguinary ant, is less common than the next. Its nests are usually under stones in grassy places along the edges of woods. It obtains slaves, or auxiliary workers by kidnapping the young of *F. subsericea.*

72. **F. sanguinea rubicunda** var. **subintegra** *Emery.* — This variety is recorded from New Jersey by Emery. I have seen a single incipient colony of it at Lakehurst, but it is probably more abundant in the less sandy portions of the State. The slaves belong to *F. subsericea* as a rule, but the colony at Lakehurst contained instead workers of *F. schaufussi*. This is probably the normal auxiliary form in this region owing to a scarcity of *subsericea* colonies. In the vicinity of New York *subintegra* is the only form of *sanguinea* I have been able to find.

73. **F. rufa obscuriventris** *Mayr.* — This subspecies is mentioned by Mayr as occurring in New Jersey. I have not seen specimens of it from this State. It is probably a western ant.

74. **F. rufa integra** *Nylander.* — Caldwell (Cresson); Clementon (Viereck); Sea Isle City (Viereck); Jamesburg (Davis); Lakehurst (Wheeler).

Our largest and most conspicuous form of *rufa*, nesting in great colonies which often comprise several nests. These are in piles of large stones or old logs and stumps. The ants stuff all the crannies of their abodes with bits of dead grass, leaves, etc. Like most other species of *Formica*, *F. integra* is much given to attending Aphides. It is most abundant in hilly regions where it prefers sunny glades or clearings in the forests.

75. **F. difficilis** *Emery.* — Some of the types of this species were received by Emery from New Jersey. I have taken a few workers near Halifax in the Ramapo Mountains.

This interesting species has very small yellow females which are in all probability temporary parasites in the nests of *F. schaufussi* var. *incerta*, as I have shown to be the case in *F. difficilis* var. *consocians* of Connecticut. The young fertilized female of this variety seeks adoption in some depauperate and probably queenless colony of *incerta* and permits her hosts to bring up her young. Later the *incerta* workers die off, leaving the *difficilis* as a pure and independent colony which soon grows rapidly in size and shows no evidence of its parasitic origin. The nesting habits of *difficilis* resemble those of *F. integra* on a small scale, especially as a colony is confined to a single nest. See my paper: 'A New Type of Social Parasitism Among Ants,' Bull. Am. Mus. Nat. Hist., Vol. XX, 1904, pp. 347–375.

76. **F. exsectoides** *Forel.* — Newfoundland (Davis); Palisades (Beutenmueller); Alpine (Am. Mus. Coll.); Ramapo Mountains near Halifax (Wheeler).

This "mound-building ant of the Alleghanies," as McCook has named it, is found nesting in open glades or clearings in the more hilly portions of the State. The mounds which it constructs of earth and vegetable débris are regularly dome-shaped and usually vary from 3–4 ft. in diameter at the base and 1–2 ft. in height. They are exposed to the sun, though often covered with living grass except at the summit. The entrances are very numerous and mostly confined to a broad girdle around the base. A single colony often extends over several mounds. The workers, which are easily distinguished from those of all our other species of *Formica* by the excised posterior border of the head, are very pugnacious. Like the European *F. exsecta* they have a habit of sawing off the heads of other ants.

77. **F. pallide-fulva** *Latreille.* — Of this typical form of the species I have seen a single worker from Cape May (Coll. Phila. Acad.). This is probably very near the northernmost range of the form.

78. **F. pallide-fulva schaufussi** *Mayr.* — Caldwell (Cresson); Camden Co. (J. B. Smith); Da Costa (Fox and Daecke); Lucaston (Daecke); Clementon (Viereck); Alpine (Am. Mus. Coll.), Fort Lee, Halifax, and Lakehurst (Wheeler).

This is one of our commonest species of *Formica.* It forms rather small colonies and nests under stones or in small obscure mound-nests in sunny and grassy fields. In the barrens about Lakehurst, where there are no stones, it nests in the dry pine logs or in the pure sand. It is timid and runs very rapidly. Its food seems to consist very largely of the excrement of Aphides and the carcases of insects.

79. **F. pallide-fulva schaufussi** var. **incerta** *Emery.* — Recorded by Emery from New Jersey. This variety is common in the same localities as the typical *schaufussi* from which it differs merely in somewhat darker coloration and in having fewer hairs on the chin and border of the petiole.

80. **F. pallide-fulva nitidiventris** *Emery.* — Recorded by Emery from New Jersey. The workers are smaller than those of the two

preceding forms, dark colored, without hairs on the chin and petiolar border, and with a more shining and less pubescent gaster. The habits are similar to those of other forms of the species.

81. **F. pallide-fulva nitidiventris** var. **fuscata** *Emery.* — Near Halifax I have taken several workers evidently belonging to this variety, which is characterized by its dark color and rather opaque gaster. It occurs in woods and seems to be less fond of the open, sunny country than the preceding forms of *pallide-fulva.*

82. **F. fusca** *Linn.* var. **subsericea** *Say.* — Caldwell (Cresson); New Brunswick (Smith); Jamesburg (Davis); Fort Lee, Great Notch, and Lakehurst (Wheeler).

Next to *Lasius niger* var. *americanus* this is the commonest of our ants in particular and of our insects in general. Like that variety it ranges from timber-line in the Rocky Mountains to the sand of the seashore and from British America to the latitude of North Carolina. It prefers sunny, grassy places and either constructs dome-shaped mounds which are larger and more definite in outline in the Middle States, or excavates its galleries under stones, boards, the bark of stumps, etc. Except when living in large colonies it is a very cowardly species. Like the other members of the genus *Formica* it attends Aphides but is equally fond of feeding on the bodies of dead insects.

83. **F. fusca** var. **subænescens** *Emery.*—Emery mentions a New Jersey specimen intermediate between *subsericea* and the true *subænescens.* There can be little doubt that the pure form of the latter variety occurs in the hilly portions of the State. It is a woodland form, preferring damper soil and more shade than the var. *subsericea.*

84. **F. fusca subpolita** *Mayr* var. **neogagates** *Emery.* — Very probably occurs in the hilly portions of the State.

Polyergus *Latreille.*

85. **P. rufescens lucidus** *Mayr.* — Camden Co. (Smith's List); Clementon (Fox); Vineland (Mrs. Mary Treat).

This rare and beautiful species, the "shining slave-maker" of McCook, or "shining amazon" as it may be called, uses the workers of *Formica schaufussi* as slaves, or auxiliaries. These are bred from pupæ kidnapped from their maternal nests by the war-like *lucidus* workers. The latter are quite unable to feed themselves, excavate their nests, or care for their own brood, but have to depend for these important activities on the *schaufussi* workers. Hence the *lucidus* are quite unable to live an independent life and may be regarded as permanently parasitic on fragments of *schaufussi* colonies which they bring together with great skill. The sexual forms make their appearance during August.

Camponotus *Mayr.*

86. **C. castaneus** *Latreille.* — Caldwell (Cresson); Sea Isle City (Viereck); Fort Lee (Beutenmueller); Great Notch (Wheeler).

This species nests in the ground, under stones or logs, or in obscure mound-nests, like the typical species of the *Camponotus maculatus* group. It is common neither in New Jersey nor New York State. The latter probably represents the northernmost range of the typical form of the species.

87. **C. castaneus americanus** *Mayr.* — Manumuskin, Iona, and Da Costa (Daecke); Jamesburg and Paterson (Davis); Halifax and Lakehurst (Wheeler).

Similar in habits to the typical form but apparently more widely distributed and ranging as far north as Massachusetts. The colonies I have seen have all been of small size. The young larvæ are salmon-colored, like those of *Tapinoma sessile.*

88. **C. herculeanus pennsylvanicus** *De Geer.* — Caldwell (Cresson); Riverton (Viereck); Medford (Phila. Acad.); Westville (Phila. Acad.); North Woodbury (Daecke); Newfoundland (Davis); Halifax (Wheeler); Fort Lee (Wheeler).

This is the common, entirely black form of the "carpenter ant." It nests usually in shady woods in old logs and stumps. Thence it migrates into old farmhouses and suburban residences and becomes a pest both by riddling the woodwork with its large anastomosing galleries and by visiting the pantries and kitchens for sweets.

89. **C. herculeanus pennsylvanicus** var. **ferrugineus** *Fabricius.* — Delair (Daecke); Camden (Viereck); Boonton (Viereck); Westville (Phila. Acad.); Fort Lee (Coll. Am. Mus.).

A beautiful color variety of *pennsylvanicus* confined, apparently, to the States east of the Mississippi River. Its habits are very similar to those of the typical form, but it seems to be much less abundant.

90. **C. herculeanus ligniperdus** *Latreille* var. **pictus** *Forel.* — Although I have seen no specimens of this variety from New Jersey, there can be little doubt that it occurs in the State, as it has been found in Pennsylvania, New York State, and Connecticut.

91. **C. marginatus** *Latr.* var. **nearcticus** *Emery.* — Boonton (Viereck); Lakehurst (Davis and Wheeler).

This, the largest and darkest form among the numerous American varieties of this ant, appears to have definite associations with pine trees. It is common at Lakehurst, nesting in the twigs and cones of *Pinus rigida.*

92. **C. marginatus** var. **minutus** *Emery.* — Great Notch (Viereck).

I have taken it at Halifax in the Ramapo Mountains and at Lakehurst, nesting in dead twigs of oaks and attending Aphides on the leaves.

93. **C. marginatus subbarbatus** *Emery.* — Westville (Schmitt); Riverton (Daecke).

In the collection of the American Museum there are specimens of all four phases of this subspecies from each of these localities. I have also taken colonies of it near Bronxville, New York, in the hollow stems of elder bushes.

Article XXIV. — WORKER ANTS WITH VESTIGES OF WINGS.

By William Morton Wheeler.

Plate XIV.

In 1878 Dewitz published an important contribution to our knowledge of the postembryonic development of the appendages in insects.[1] Among the forms which he studied were the worker larvæ and pupæ of a common European ant (*Formica rufa*). He investigated their imaginal discs and discovered minute vestiges of wings which could be traced into the pupa stage. Concerning these structures he says (p. 82): "The imaginal discs of the vestigial wings arise later than those of the legs but nevertheless before the last larval ecdysis. They are situated on the sides of the two posterior thoracic segments, near their hind margins, and are drawn down close to the ventral surface [Pl. XIV, Fig. 1 *b* and *c*]. Hence they are much further from the row of stigmata than from the leg-discs and lie just above the broad muscle band that runs along each side of the ventral surface. An elongate thickening with its two ends directed towards the ventral and dorsal surfaces and having a long slit-shaped invagination, arises in the hypodermis. The disc enlarges while the invagination progresses inward, so that two parts are differentiated, as in the development of the legs: an enveloping membrane and lying within it a more massive portion, the rudiment of the wing."

The further development of these "wing-pockets corresponds exactly with that of the leg-pockets. Each is an invagination of the hypodermis towards the interior of the body and opens outward by means of an orifice. In both cases growth is accompanied by an enlargement of the enclosed appendage."

During the pupal stage of the worker "the wings do not increase in size, since they have reached the acme of their growth in the fully developed larva." Traces of the wings are still visible in the semipupa[2] but the little sacs finally flatten out and apparently become portions of the general hypodermis in the older pupa. Dewitz shows, nevertheless, a small vestige of the hind wing in a profile view of the thorax of a completed worker pupa (Pl. XIV, Fig. 2 *b*).

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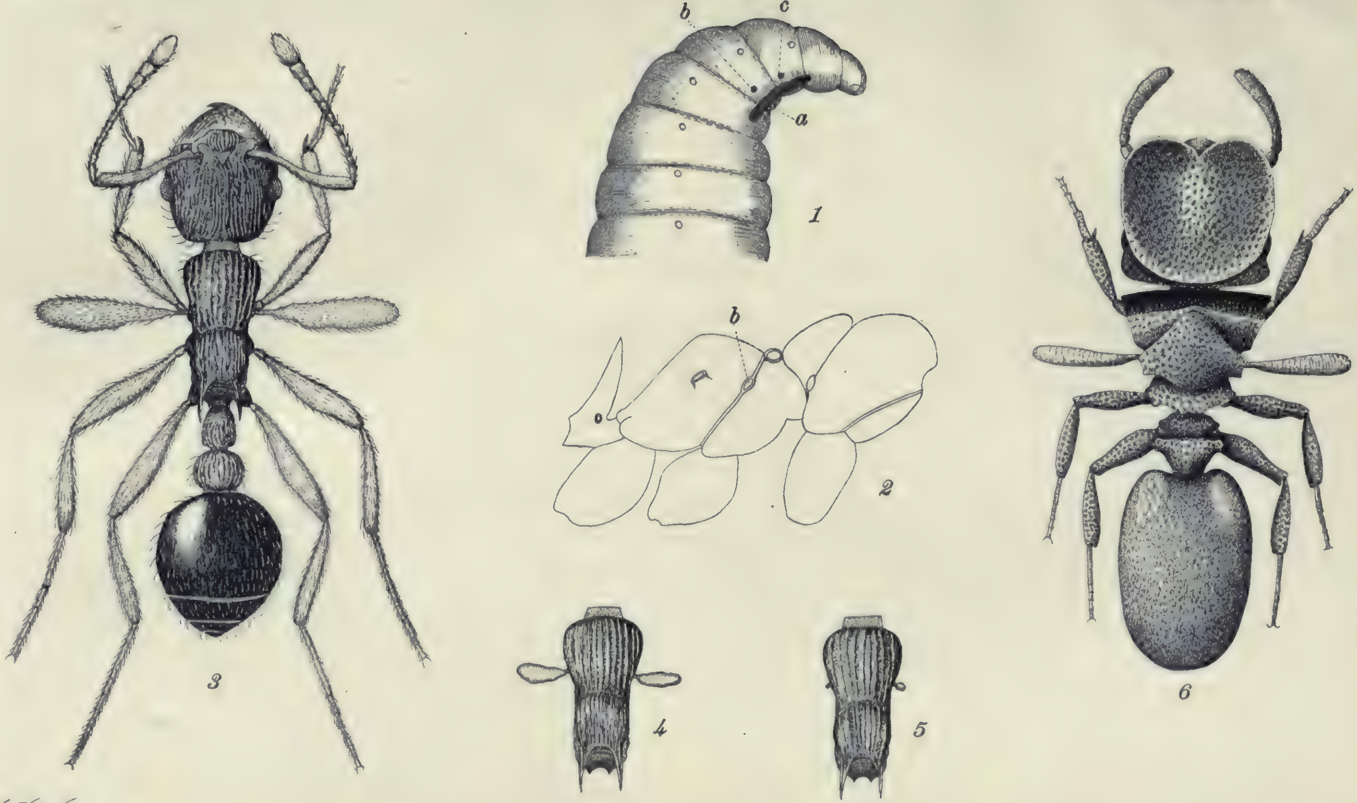
[1] Beiträge zur postembryonalen Gliedmassenbildung bei den Insecten. Zeitschr. f. wiss. Zool., XXX, Suppl., 1878, pp. 78–105, Taf. V.

[2] According to Dewitz the term *semipupa* was introduced by Packard (Observations on the Development and Position of the Hymenoptera, with Notes on the Morphology of Insects. Proc. Boston Soc. Nat. Hist., Vol. X, Boston, 1866) and the term *pseudonymph* was subsequently given to the same stage by von Siebold (Beiträge zur Parthenogenesis der Arthropoden, Leipzig, 1871, p. 35). Although von Siebold's term seems to be the more generally used, especially in Germany Packard's term not only takes precedence but is simpler and more appropriate.

Owing to the high degree of variability so characteristic of vestigial organs, we should expect occasionally to find adult worker ants bearing these structures, especially traces of the larger anterior pair of wings, in a more or less imperfect state of development. And the probability of finding such workers would seem to be the greater on account of the vast number of these insects born into the world during every month of the warm season. Among the thousands of workers that have come under my observation during the past six years, I have, in fact, succeeded in finding four winged individuals belonging to two colonies of two different species. While this is a very small percentage of the total number of specimens examined, it must be borne in mind that the wing-vestiges are sometimes very minute and easily detached, so that workers actually hatched with these interesting appendages may rub them off while excavating, or have them torn off by their sister workers while undergoing final ecdysis, or while submitting to the mutual shampooing to which these insects devote so much of their leisure.

Sept. 5, 1904, I found at Bronxville, New York, a small colony of a form of *Myrmica rubra scabrinodis* near the variety *schencki* Emery. This colony comprised about 150 workers and a deälated female of rather small size. Three of these workers bear vestiges of anterior wings but are in every other respect perfectly normal individuals. In the structure of the thorax there is not the slightest approach to the female type. Each of the three specimens represents a different condition in the development of the wings. In one (Fig. 3) the wing vestiges are nearly 1.7 mm. long, spatulate in outline and very slender at their bases where they are furnished with small but distinct tegulæ. The appendages are yellowish brown, translucent and covered with minute hairs like those on the normal wings of females, but without any traces of venation. In another worker (Fig. 4) the wings are barely .4 mm. in length and are merely little opaque pads or sacs, without even a trace of hairs on their surfaces, although they have minute tegulæ at their bases. In the third specimen (Pl. XIV, Fig. 5) the wings are even more vestigial, the right being represented by a small nodular appendage and its tegula, the left by a minute papilla. In all of these workers the vestiges represent anterior wings, as is shown by their insertion just behind the suture which sharply separates the pro- and mesothoracic segments in the region of the pleuræ but not on the dorsal surface. It is very probable that the ants were quite unable to move these appendages. In the dead specimens they are applied to the mesopleuræ with their tips directed ventrally and


b
c
a
1
b
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P. B. Whelpley, del.

Worker Ants with Vestiges of Wings.

posteriorly, like the wing-pads in the pupæ of normal males and females, and do not stand off at right angles from the thorax as represented, for the sake of clearness, in the figures. The two specimens with more considerable vestiges are a trifle larger than the majority of the workers in the colony, but this, apart from the wings, is the only character in which they approach the female.

The only other worker ant with wing vestiges in my collection is a soldier of *Cryptocerus aztecus* Forel taken Dec. 27, 1900, by myself from a normal colony that was living between the leaves of an epiphytic Tillandsia near Cuernavaca, Mexico. This specimen (Fig. 6) is in every respect a perfectly normal worker major, or soldier of its species, except that it bears on the external angles of the mesonotum a pair of symmetrical organs representing anterior wings. These are shaped very much like those in the first of the above-described *Myrmica scabrinodis* workers. They are .8 mm. long, spatulate, yellowish brown in color, opaque at the base but semi-transparent towards their tips. Their surfaces are transversely wrinkled but hairless. The tegulæ, if present, are extremely minute. In the dried specimen the vestiges are directed ventrally and posteriorly like the wing rudiments in the normal female pupæ of Myrmicine ants.[1]

We must assume that in all the above cases the wing vestiges which, in worker ant larvæ, are extremely minute and normally disappear in the pupa stage, have, so to speak, been fanned into greater activity of growth by some unusual and unknown stimulus during ontogeny and have persisted till the imaginal stage without, however, attaining to any functional significance.

The specimens above described not only confirm but emphasize Dewitz's conclusion that worker ants must once have possessed functional wings like those of the existing workers of social bees and wasps. This is evidently only a special case of what Dewitz expresses as a general law, now universally accepted by entomologists: "If only one of the sexes of an insect species is winged we must regard the wingless condition of the other as acquired during phylogenetic development." This statement is also clearly applicable to ants, provided we insert the words "one phase of a sex" in the place of "one of the sexes."

The above-described workers with vestigial wings evidently belong to the category of abnormal forms intermediate between normal worker and female ants, like the ergatoid females and pseudogynes.

---

[1] This same winged soldier of *Cryptocerus aztecus* is also briefly described by my former pupil Miss Margaret Holliday in her paper entitled 'A Study of Some Ergatogynic Ants.' Zool. Jahrb. Abth. f. Syst., XIX, 4, 1903, p. 315.

While these latter, however, tend to resemble the normal female in the structure of the thorax but, like normal workers, lack wings, the workers above described have vestiges of wings but show no similarity to the female in the structure of the thorax. They therefore represent a distinct and hitherto apparently unknown group of gynæcoid abnormalities for which I would suggest the name *pterergates*.

Postscript.

While this paper is going through the press I find in a collection of ants made in Isle Royale near the northern shore of Lake Superior and sent me by Dr. Chas. C. Adams of the University of Michigan, three peculiar workers of a new variety of *Myrmica rubra sulcinodis* Nyl. They resemble one another and approach the female in the structure of the thorax. The mesonotum is delimited anteriorly by a distinct suture, is larger and more convex than that of the normal worker, and has finer longitudinal rugæ. There is a small and indistinct scutellum but no traces of ocelli. Two of the specimens have vestigial fore wings but on the left side only. In one the vestige is a minute nodule like that on the left side in one of the *M. scabrinodis* workers above described (Pl. XIV, Fig. 5). In the other the vestige is about the size of those shown in the worker represented in Fig. 4, but more shrivelled. These three abnormal *sulcinodis* workers resemble a worker of the same species described by Wasmann (Die ergatogynen Formen bei den Ameisen und ihre Erklärung, Biol. Centralbl., XV, No. 16 u. 17, 1895, p. 609) except in possessing wing vestiges. I believe it would be best to regard them all as pseudogynes, although these forms, which are well known in certain Camponotine genera (*Formica*, *Polyergus*, and *Camponotus*) are described by Wasmann as "stets ungeflügelt" (*loco citato*, p. 606).

EXPLANATION OF PLATE XIV.

Fig. 1. — Anterior portion of adult worker larva of *Formica rufa* showing imaginal discs for legs at *a*, and at *b* and *c* vestigial imaginal discs for the hind and fore wings, respectively. After Dewitz.

Fig. 2. — Thorax and petiole of adult worker pupa of *Formica rufa* showing vestige of hind wing at *b*. After Dewitz.

Fig. 3. — Worker of *Myrmica rubra scabrinodis* Nylander var. with vestigial fore wings.

Fig. 4. — Thorax of a second worker of the same ant with more reduced fore wing vestiges.

Fig. 5. — Thorax of a third worker with still more reduced fore wing vestiges

Fig. 6. — Soldier of *Cryptocerus aztecus* Forel with vestigial fore wings.

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Article XXV. — ON THE STRUCTURE OF TWO IMPERFECTLY KNOWN DINICHTHYIDS.

By L. Hussakof.

Plates XV–XVII.

During the past year the American Museum secured a small but valuable assemblage of sharks and "placoderms" from the Devonian (Cleveland shale) of Ohio, brought together by the veteran Ohio collector, Rev. Dr. William Kepler. This collection came into my hands for examination and cataloguing; and in going over the specimens several facts were made out which throw additional light on the structure of the two Arthrodires, *Dinichthys curtus* and *D. clarki* (=*Gorgonichthys*). These facts are briefly presented in the present paper.

I may add that this material was placed at my disposal by the Honorary Curator of fishes, Professor Bashford Dean, and that I am further indebted to him for many helpful suggestions made during the course of my work.

Dinichthys curtus *Newb.*

The structure of this species is still imperfectly known. Some of its principal elements, *e.g.*, the dorso-median, "clavicular," postero-ventro-lateral, and ventro-medians have not yet been described; while of the plates already known, especially those of the cranial shield, a critical review is needed in the light of new material.

In the present collection the remains, still retained in a large concretion of shale, are evidently those of a single individual, and, while incomplete and rather poorly preserved, are valuable because of their association. I here describe only those features which contribute to our understanding of this form.

Cranial shield (Pl. XV, Fig. 1). — Only the impression of a fragment from the left side of the cranium is preserved, the bone itself being entirely weathered away. The fragment shows the sutures and the canal system, both of which are clearly brought out in a cast prepared from the impression. This portion of the head-shield, it is noticed, is too small to warrant an altogether accurate restoration of the entire cranium, but with major probability it substantiates Professor Newberry's statement on page 156 of his Palæozoic Fishes of

North America, that the cranial shield, both in size and in the arrangement of its elements, resembles most closely that of *D. intermedius*. The canals and sutures, which were not referred to in detail by Newberry, entirely agree, as far as the present fragment goes, with those of *D. intermedius*, but are, of course, relatively smaller.

Dorso-median (Fig. 1.). — This element in *D. curtus* does not appear to have been described. In the present specimen the left-hand half alone is preserved showing the ventral aspect. Both the keel and the posterior process are wanting. From the fragment it appears that the *curtus* dorso-median differs in no essential point from that in any other species of *Dinichthys*. The fragment clearly indicates an anterior emargination and somewhat acute antero-lateral angles.

Length (excluding process), 190 ± mm.
Width (of fragment), 105 mm.
Estimated total width, 220 mm.

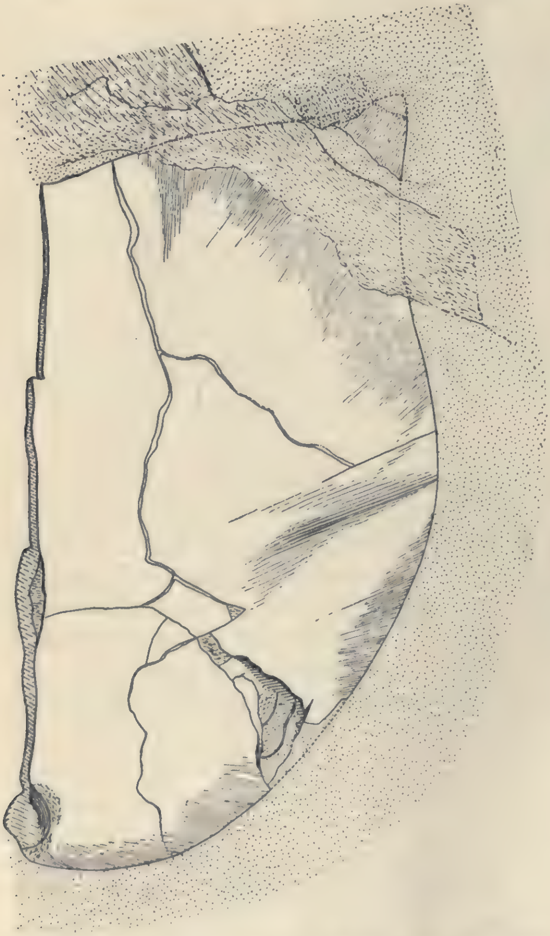
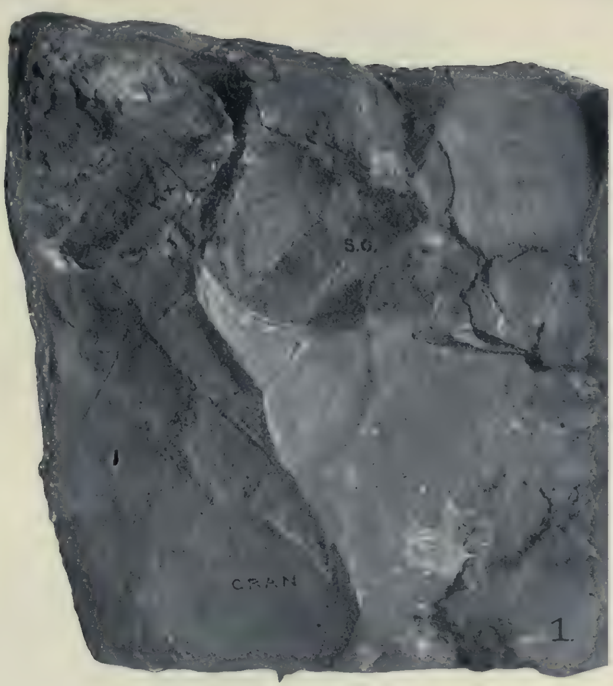


Fig. 1. *Dinichthys curtus* Newb. No. 7072. Left half of Dorso-median, internal aspect. Cleveland shale, Ohio. × ½.

"Clavicular." — This element in *D. curtus* has hitherto not been described. In this specimen large portions of both elements are present though poorly preserved. Except for a difference in size they are entirely like those of *D. intermedius* (Pl. XVI, Fig. 2).

Gnathal elements. — Nearly the complete dentition of the indi-



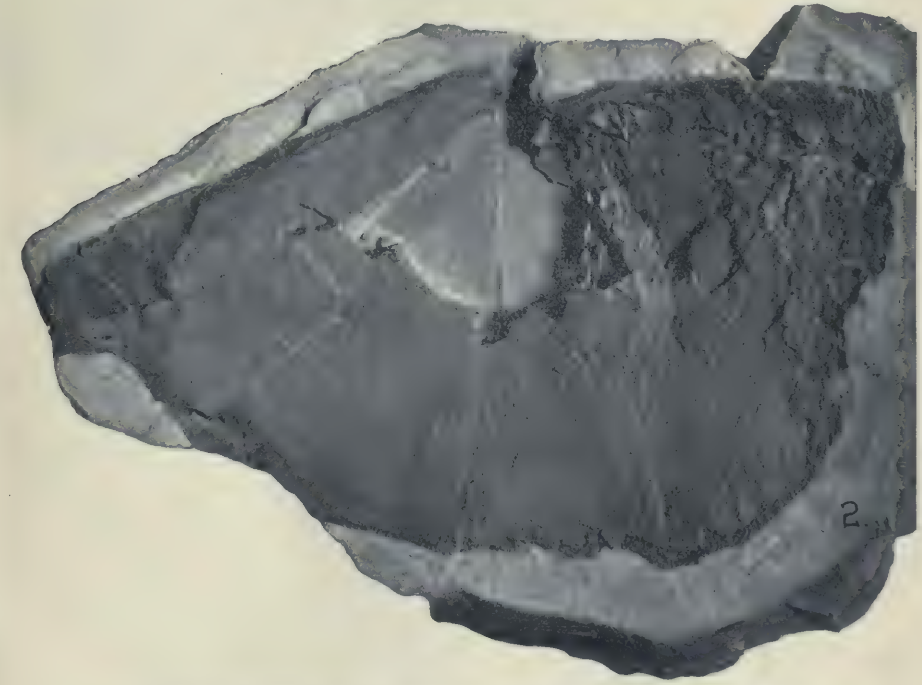
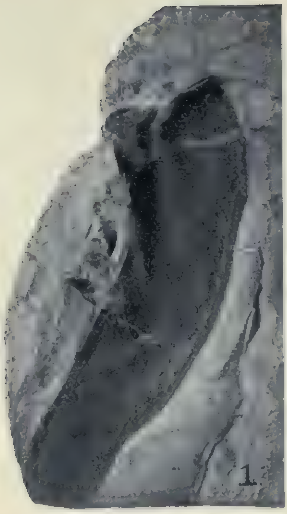
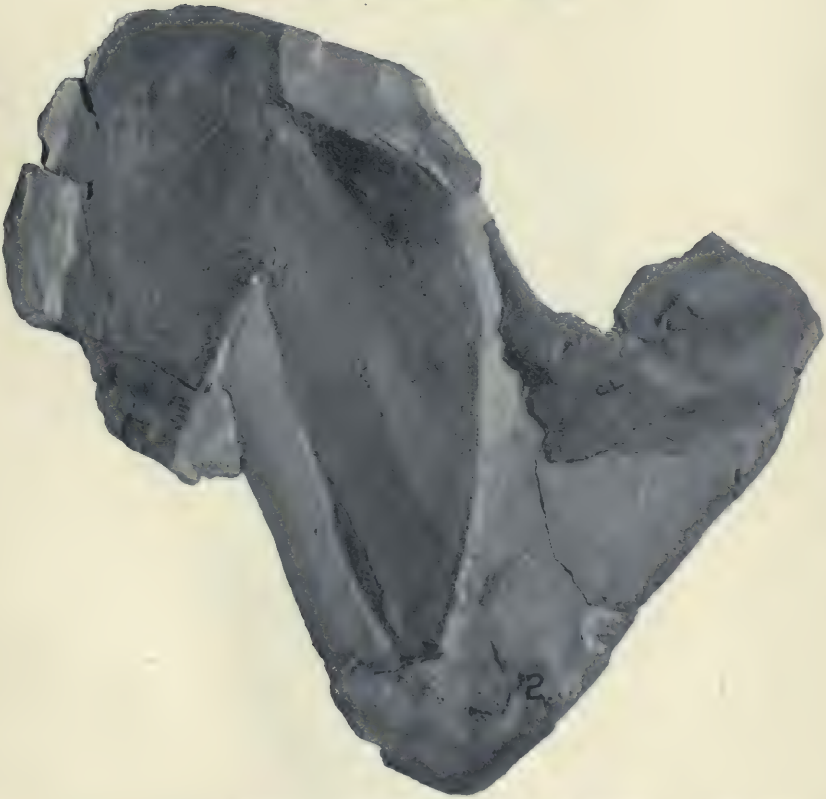


FIG. 1. *Dinichthys curtus* Newb. Cranial plates in the matrix. × ⅓. Cleveland shale, Ohio. No. 7071. *CRAN*, impression of left half of cranium; *Mx*, "maxillary"; *S. O.*, suborbital.

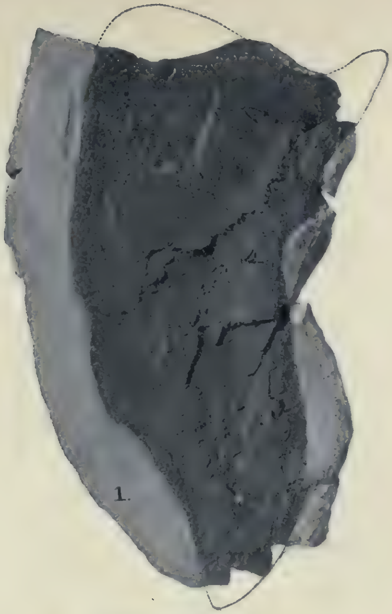
FIG. 2. *Dinichthys clarki* Claypole. Antero-dorso-lateral, visceral aspect. × ¼. Cleveland shale, Ohio. No. 7039.

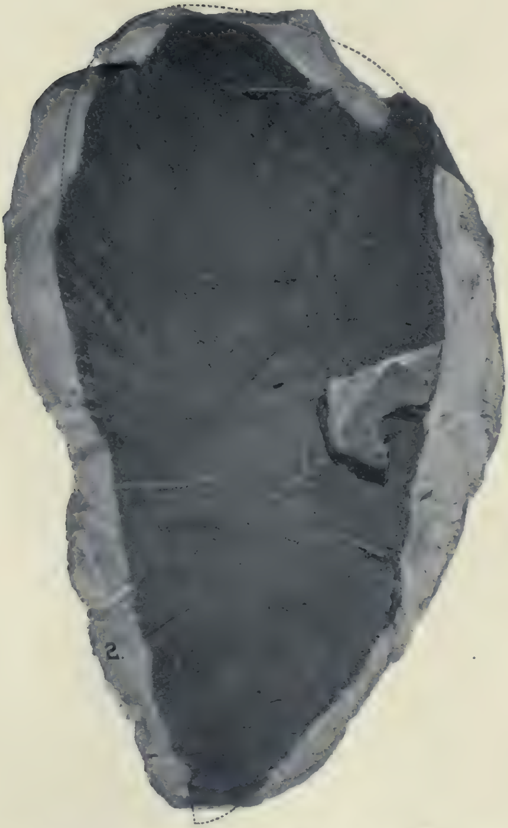




DINICHTHYS CURTUS NEWB. VENTRAL PLATES IN THE MATRIX. CLEVELAND SHALE, OHIO.

FIG. 1. Left antero-ventro-lateral, visceral aspect. × ¼. No. 7048.
FIG. 2. Postero-ventro-laterals, visceral aspect. *CL*, portion of the clavicular. × ¼. No. 7047.





DINICHTHYS CLARKI CLAYPOLE. VENTRAL PLATES IN THE MATRIX. CLEVELAND SHALE, OHIO.

FIG. 1. Right antero-ventro-lateral in visceral aspect. × $\frac{1}{8}$. No. 7038.
FIG. 2. Right postero-ventro-lateral in visceral aspect. × $\frac{1}{6}$. No. 7041.

vidual is preserved, the right "maxillary" alone, missing. The elements have been fully described by Professor Newberry [1] and by Dr. Eastman [2] and no description of them is here deemed necessary. It need only be pointed out that the specific character of the "mandible" as consisting in the presence of *two* cusps on the cutting edge following the main upturned "tooth," needs further examination. A careful comparison of several "mandibles" in this and in other species convinces the writer that the additional cusp — the more anterior of the two — is due to individual variation in the cutting action of the jaw, the condition in *D. curtus* being approximated in some specimens of *D. intermedius*. Again, this cusp is not strengthened by a vertical bar of bone as is the other cusp. Were it, then, a question of jaws only, *D. curtus* might reasonably be regarded as but a variety of *intermedius*.

The measurements of the gnathal elements are as follows:

Left "mandible,"	length, 236 mm.
" "	height, at tooth, 72 ± mm.
Left "premaxillary,"	height (from tip of tooth to upper margin), 70 mm.
" "	width at process, 40 mm.
Left "maxillary,"	length, 90 mm.
" "	width just in front of process, 40 mm.

Ventral armor. — The ventral plates in this dinichthyid are similar in plan, and differ only in detail from those in the other species familiar to the writer. An almost perfect antero-ventro-lateral and both postero-ventro-laterals with their counterparts are represented.

The antero-ventro-lateral belongs to the left side and here exhibits its visceral face (Pl. XVI, Fig. 1). It agrees in proportions with that [3] figured in external view by Newberry. As pointed out by Newberry, this element is relatively narrower in proportion to its length than the antero-ventro-lateral in any other species of *Dinichthys*.

Length, 245 mm.; about 2 mm. missing at posterior end.
Width, at about middle, 60 mm.

The postero-ventro-laterals in *D. curtus* are here described for the first time. A reference to the figure (Pl. XVI, Fig. 2) gives their form and proportions. They are exhibited in ventral aspect.

Measurements of the right-hand plate:

Length of preserved portion, 280 mm.
Estimated length, 290 mm.
Width at middle, 103 mm.

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[1] Palæozoic Fishes of North America, p. 157.
[2] Dentition of Some Devonian Fishes. Journ. Geology, Vol. VIII, 1900, pp. 32–41.
[3] *Loc. cit.*, Plate L, fig. 2. Newb. Coll., No. 227.

A restoration of the ventral armor is suggested in the text, Fig. 2.

Sub-orbital (Pl. XV, Fig. 1.). — The left element is preserved. It is in shape like its homologue in other species.

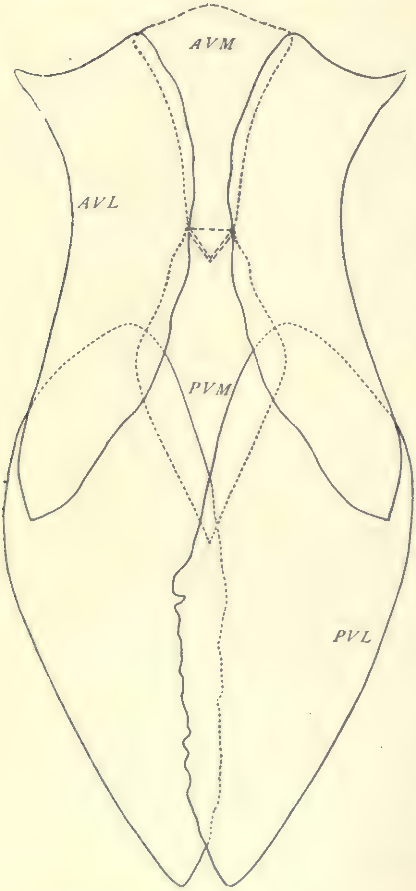

Fig. 2. *Dinichthys curtus* Newb. Restoration of ventral armor. × ¼. *AVM*, antero-ventro-median; *AVL*, antero-ventro-lateral; *PVM*, postero-ventro-median; *PVL*, postero-ventro-lateral.

Conclusion. — We are now in a position to define the specific characters of *D. curtus* Newberry. In general, this species most strongly resembles *D. intermedius*, though only about two-thirds its size. Professor Newberry has pointed out the agreement with that species in cranium, "maxillary"[1] and "mandible." My material extends this similarity to the dorso-median, the sub-orbital, and the "clavicular." The distinctive characters of the species, then, must be sought in other plates: in the antero-dorso-lateral, which Professor Newberry declares is "relatively broader than in any other species known"; in the antero-ventro-lateral, which is narrower in proportion to its length than that in any other species; in the characteristic outline of the postero-ventro-lateral; and, to a lesser degree, in the "mandible."

Dinichthys clarki *Claypole*

In 1892 Claypole described a huge toothed mandible from the Cleveland shale of Ohio to which he gave the name *Gorgonichthys clarki*.[2] In 1900, Dr. C. R. Eastman maintained the generic identity of this genus with *Dinichthys*, pointing out that "the mandible displays an interesting stage of modification between denticled forms like *D. herzeri*, *D. halmodeus*, etc., on the one hand, and those with a sharp cutting edge like *D. terrelli* on the other." and proposed to change the name to *D. clarki*.[1] This view is adopted in this paper, especially in consideration of certain facts concerning the body plates, presently to be described. In what follows, therefore, the term *D. clarki* is employed.

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[1] *Loc. cit.*, p. 156.

[2] Amer. Geologist, Vol. X, 1892, pp. 1–4.

The species is represented in the collection by several large fragments, which when carefully put together and studied proved to be (1) a "mandible" and (2) three body plates. None of the latter class of elements in this species have hitherto been described, although a large postero-ventro-lateral preserved in the Ohio State Museum and thought by Eastman to belong to *D. herzeri*, is regarded by the writer, for reasons to be given later, as probably of this species.[2]

"*Mandible*." — There came with the Kepler Collection the posterior two-thirds of a right "mandible" embedded with its visceral face in matrix. It possessed three denticles. It was carefully removed from the matrix and compared with a "mandible" of *D. clarki*, and it looked so much like the latter, that no hesitation was felt in labelling it as such. Subsequently it was discovered that the element could very well stand as the type of what was figured by Claypole as a new species and named by him *D. kepleri*.[3] There is no doubt that the "mandible" in question is Claypole's type specimen. He speaks of it as remaining in the possession of Dr. Kepler; of being broken across at the middle; and on comparing it with his figure and measuring by his scale, all doubt is removed. The specimen is somewhat smaller than either of two splendid "mandibles" of *D. clarki* in the Museum collections, and it belongs probably to an immature individual. Dr. Eastman at one time, arguing presumably from Claypole's description, regarded this specimen as belonging to *D. herzeri*; and upon this evidence, as well as upon a huge postero-ventro-lateral some 75 cm. long which he regarded as also belonging to this species, he urged the presence of *D. herzeri* in the Cleveland shale. But the writer's interpretation of this same "mandible" as that of *D. clarki*, and his conviction that the postero-ventro-lateral, to be mentioned, also belongs to the latter species, since it differs both in size and proportions from that of *D. herzeri* (see table, p. 414), proves the absence of *D. herzeri* from the Cleveland shale and its restriction to the Huron.

Antero-dorso-lateral (Pl. XV, Fig. 2).—The plate preserved is from the right-hand side and exhibits its visceral surface. In general form, it resembles the antero-dorso-lateral in other species. A break in the bone in the middle line shows in the matrix, a long narrow ridge, the cast of the lateral line of the dorsal side. This has the same direction as in all similar plates. A slight excavation in the posterior margin near one side, characteristic of most species, is here also present. The articulating process is crushed into the plate, and its anterior portion is entirely broken away.

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[1] *Loc. cit.*, p. 35.

[2] Professor Dean informs the writer that an almost complete specimen of this species is preserved in the British Museum in the Clark Collection.

[3] A new *Dinichthys—Dinichthys kepleri*. Amer. Geologist, Vol. XIX, 1897, pp. 322–324, pl. 24.

Greatest width, 450 mm.
Length at the lateral line, 270 mm.

Antero-ventro-lateral.—The plate figured (Pl. XVII, Fig. 1) is the right-hand one, and it exposes the external (ventral) surface. Its counterpart is also in the collection and supplies some portions of the outline not brought out in the original. It is noted that the plate, like the others here described, differs, outside of size, only in minor details from those in *D. terrelli* — which confirms Dr. Eastman's view that this form is only another species of *Dinichthys* and not a different genus.

Length, 500 mm.
Width at middle, 170 mm.

Postero-ventro-lateral. — This plate is identical in form with that in *D. terrelli* but much larger (see table below). The right-hand plate is preserved in the collection, on its visceral surface (Pl. XVII, Fig. 2). Its dimensions are as follows:

Length, 750 mm.
Greatest width, 300 mm.

In the table which follows are given, for comparison, the proportions of the postero-ventro-laterals of *D. herzeri* and *D. terrelli* with those of the present species. The measurements are taken from specimens in the Newberry Collection, those of *D. herzeri* being from the type plate. This comparison, it seems to the writer, justifies the conclusion that the element here described is neither that of *D. terrelli* nor of *D. herzeri.*

MEASUREMENTS OF THE POSTERO-VENTRO-LATERALS.

Species.	Length.	Width (greatest).	Ratio of Width to Length.
D. herzeri	64 cm.	33 cm.	.51
terrelli	61	27	.44
clarki	75	30	.40

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